Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
AP1000 Subcommittee Meeting

Docket Number: (n/a)

Location: Rockville, Maryland

Date: Friday, August 19, 2016

Work Order No.: NRC-2540 Pages 1-448

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

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AP1000 SUBCOMMITTEE

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FRIDAY

AUGUST 19, 2016

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ROCKVILLE, MARYLAND

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The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B1, 11545 Rockville Pike, at 8:31 a.m., Harold B. Ray, Chairman, presiding.

COMMITTEE MEMBERS:

HAROLD B. RAY, Chairman

DENNIS C. BLEY, Member

RONALD G. BALLINGER, Member

CHARLES H. BROWN, JR. Member

MARGARET CHU, Member

MICHAEL L. CORRADINI, Member

WALTER L. KIRCHNER, Member

JOSE A. MARCH-LEUBA, Member

DANA A. POWERS, Member

JOY REMPE, Member

PETER RICCARDELLA, Member

GORDON R. SKILLMAN, Member

JOHN W. STETKAR, Member

DESIGNATED FEDERAL OFFICIAL:

PETER WEN

ALSO PRESENT:

DANIEL BARNHURST, NRO

LAWRENCE BURKHART, NRO

LUISSETTE CANDELARIO, NRO

TSE-JER CHUANG, NRO

MANNY COMAR, NRO

JENNIFER DIXON-HERRITY, NRO

KENNETH ERWIN, NRO

ROBERT FITZPATRICK, NRR

STEVE FRANZONE, FP&L

JOSEPH GIACINTO, NRO

ZACHARY GRAN, NRO

ZACH HARPER, Westinghouse

DAVID HEESZEL, NRO

PHIL HOGAN, FCL

PAUL JACOBS, FP&L

KEN JHA, Bechtel

BERND LASKEWITZ, Westinghouse

PATRICK LYNETT, USC*

ROBERT MALIVA, Parson Brinkerhoff

DAVID McNABB, MHC

WILLIAM MAHER, FP&L

JAMES MARRONE, Bechtel

MELANIE MAYES, NRO

BRUCE MUSICO, NRO

RICHARD ORTHEN, FP&L

FARHANG OSTADAN, Bechtel

PRAVIN PATEL, NRO

MALCOLM PATTERSON, NRO

MERALIS PLAZA-TOLEDO, NRO

KEVIN QUINLAN, NRO

RUTH REYES, NRO

MARY RICHMOND, Bechtel

PAUL RIZZO, Paul C. Rizzo Associates, Inc.

MUSTAFA SAMAD, Bechtel

DOGAN SEBER, NRO

ELLEN SMITH, NRO

LISA SCHLEICHER, NRO

ALICE STIEVE, NRO

PHILIP STODDARD, Public Participant

RAO TAMARRA, NRO

STEWART TAYLOR, Bechtel

LEE TUNON-SANJUR, Westinghouse

ZUHAN XI, NRO

*Present via telephone

T A B L E O F C O N T E N T S

Opening Remarks and Objectives -
Harold B. Ray, ACRS.....6
Chap. 2.5 - Geology, Seismology and Geotechnical
Engineering 18
Chap. 3.5 - Hurricane Missiles.....135
Chap. 3.7 - Seismic Design.....164
Chap 13.3 - Emergency Planning.....177
Chap. 19 - PRA (DEP 19.58-01 Severe Winds and
Tornadoes.....203
Chap. 20 - Requirements Resulting from Fukushima
Near Term Task Force Recommendations.....210
Chap. 21 - Design Changes.....231
Adjourn.....253

P R O C E E D I N G S

8:30 a.m.

CHAIRMAN RAY: The meeting will resume the second day of the subcommittee AP1000, which is reviewing the COLA from FPL for Turkey Point 6 and 7.

Shall I start again? I must be -- I was just about to say, I hope we can do as well on the schedule today as we did yesterday, but then I wound up taking up time with nothing.

Anyway, so we'll resume the AP1000 subcommittee review of the FPL COLA for Turkey Point 6 and 7, this being the second day.

A couple of things to take care of first and right off, Member Stetkar has asked to have an opportunity to put some information on the record.

So, John, please.

MEMBER STETKAR: Yeah, thanks, Harold.

I appreciate whoever got us the RAI on the Aircraft Crash Analysis. I appreciate that. That was very, very helpful.

I was pretty critical yesterday about the Aircraft Crash -- had quite a few questions especially for airport operations at Homestead Air Force Base. So, I now fully understand what the

applicant did. I have reproduced their numbers.

And I've always been bothered a little bit about the DOE standard, because it -- people who do this will understand what I'm talking about and I don't need to elaborate -- it lulls you into the notion that the values in there are extremely precise. They're very small numbers and they're very precise and, in fact, it's built on somebody's model.

It's not a bad model. It's a decent concept, I mean, if you look at the basic stuff. So, I wanted to make sure I understood what the applicant had done and then I played around with it a little bit to not quite be precise about exactly which square you fall into.

And depending on what assumptions you make about kind of smearing the areas, the first -- the first cut that I took and I mentioned yesterday when I did a real crude analysis, I came up with an impact frequency at the site of, I'll just say, a couple of times 10 to the minus six per year. So, that's why I was a little surprised that the applicant's frequency was a couple of times 10 to the minus seven.

Last night as I learned a little bit

more about the assumptions that they had made and tried to stick to a lot of them, I think somewhere in the middle minus seven per year is probably reasonable.

I had a couple of cases that came out a little higher than 10 to the minus six, but the long and the short of it is somewhere in the middle minus seven range is okay and it -- I understand what was done and the model they used is okay and it's not 2.56 times 10 to the minus seven, three significant figures, but it's probably kind of middle minus seven-ish.

So, I just wanted to put that on the record and say I'm okay, I understood what they did and I'm not going to quibble over factors of two or three or something like that on those kind of numbers.

CHAIRMAN RAY: Thank you, John.

I've also been asked to, again, plead with those who are on the public line listening in to put their phones on mute, because others on the line are finding it hard to hear what's going on here in the room because of background noise from those who are connected to the line.

A couple of other housekeeping items

again based on yesterday and making sure we got an agenda that will get us to the end here today.

The staff was asked a question by Chairman Bley, who will be joining us here in a while, concerning an open-phase issue. They're prepared to present that and will do so when they first come up today, in all likelihood. And we've got a phone line set up to assist with them doing that.

Member Brown had a question about detection of undiluted releases if they were to occur. And I've asked the applicant to discuss that a little bit more at some point of their choosing today.

And then finally, I've also asked the applicant to discuss at a time of their choosing, the -- in some more detail something that we discussed -- or that was part of our review yesterday, but wasn't discussed in any detail, I asked them to discuss in some further detail, and that is the basis of their assumptions about sea level and sea level rise so that we understand what their application is based on and have an opportunity to have any questions asked.

With that, I'll finally ask, as usual,

that any mobile devices in the room be silenced. And with that, I'll turn to the applicant who's first up on our agenda today and, Steve, I ask that you come up and begin.

MR. FRANZONE: Steve Franzone, Florida Power & Light.

First off, we'd just like to update you on the sea level rise. And then after that, we'll start on the 2.5 presentation.

CHAIRMAN RAY: Whatever order you wish.

MR. FRANZONE: Okay. And so, we have Mustafa Samad from Bechtel. He's going to discuss the -- our assumption on the sea level rise.

MR. SAMAD: Good morning. First of all, I would just say that the sea level rise that -- the projection of the sea level rise that we consider in our assessment is part of evaluating the maximum -- the storm surge height -- or the pro maximum storm surge height, and that would define the design basis flood elevation for our site.

So, the way the sea level rise is included in that assessment is that it provides the antecedent water level condition. So, what is the water level that we start with having the surge move on.

So, having said that, there are two clear components to that antecedent water level condition. One is the 10 percent exceedance high spring tide that I explained yesterday, which is the highest -- the average of the highest monthly spring tides over a 21-year period. And in addition to that, we have also sea level rise adding up to that.

The overarching like kind of consideration for us to define the design basis flood elevation for the site is to have sufficient modeling so that we account for like unknowns and the data limitations that we are basing our analysis on.

The seal level rise component is one of that, like one part of that whole assessment of the pro maximum surge elevation.

The sea level rise that we based our assessment on is all based on (indiscernible) data from nearby tidal stations. So, we --

CHAIRMAN RAY: Wait. Wait. Go through that a little more so we -- the very last thing you said. The sea level rise we based our assumptions on, and then -- say it more carefully.

MR. SAMAD: Yeah. What I say here is

that the sea level rise in our assessment is based on tidal gauge observation data from nearby tidal --

CHAIRMAN RAY: So, do I understand that that is -- it's not based on projections that you might have gotten from any government source or whatever?

MR. SAMAD: No. The projection we did, we made our analysis based on data that we received from the common sources.

CHAIRMAN RAY: But were they projections, or just data that --

MR. SAMAD: It is projection.

MR. FRANZONE: I think what he's asking -- again, Steve Franzone. We took data and made our own projections --

MR. SAMAD: Exactly. That's --

MR. FRANZONE: -- based on the NOAA data that we got from the tide stations.

MR. SAMAD: So, the data we have is -- basically, we looked at two stations -- the data from two stations. One station, which is closest to the site, has data from 1931 to 1981. So, 51 years of data, but this ends at 1981.

The other stations that we looked at, which is quite far away from our site, has data from

1913 through 2010, which is the period of our assessment.

And then we looked at different types of assessment and combination of the data so that we can further recreate the data that would have been the site -- the station closest to the site. So, we used the two stations' correlation to do that.

CHAIRMAN RAY: Well, all right. Talking about the other -- the issue, obviously, is icecap melting and the contribution that has to sea level rise. None of which is perhaps reflected in the data to date.

The question is, is there any allowance for the future that has to do with speculation, I'll call it -- that's perhaps unfair, but that has to do with projections which are based on assumptions about that occurrence?

MR. SAMAD: Yes.

CHAIRMAN RAY: And get as close to yes or no as you can in your answer.

MR. SAMAD: Yes, we have allowances for that -- that projection. The sea level rise range that we came up with is about 0.8 foot for 100 year.

CHAIRMAN RAY: Okay. 0.8 foot for 100 years.

MR. SAMAD: Is the range.

CHAIRMAN RAY: It's one foot as you showed it --

MR. SAMAD: Sure.

CHAIRMAN RAY: -- but that's fine. I understand.

MR. SAMAD: Yeah, I mean, we used one foot for 60-year period. So, if you take 60 year from 0.8 foot, which comes to about half a foot, but we just take it to one foot full for that 60-year period.

CHAIRMAN RAY: All right. But your view is, and I'm not -- I don't want to put words in your mouth, but your view is that that adequately accommodates projections of increased rate of sea level rise associated with changes that are projected to take place going forward.

MR. SAMAD: That's correct.

CHAIRMAN RAY: And we're in progress now, perhaps?

MR. SAMAD: Yes. That's our determination in defining the design basis flood elevation for the site.

CHAIRMAN RAY: Well, I understand that's how you use it, but I'm just asking a question about

how did -- where did the basic rise assumption come from?

And I believe I understand you to say that it's based on prior data, but going forward it does take into account some increased rate which is a reflection of at least somebody's projections of the effect of --

MR. SAMAD: Yeah.

MEMBER STETKAR: I'm not sure -- I didn't hear him say "increased rate."

So, when you did your extrapolation out over the next 70 years, did you just linearly extrapolate your 1913 to 2010 data?

MR. SAMAD: Yes, we did.

MEMBER STETKAR: Okay. So, he did not take an increased rate.

CHAIRMAN RAY: Okay. I was --

MEMBER STETKAR: So, I want to make sure that's on the record.

CHAIRMAN RAY: I mean, I was basing that on the --

MR. SAMAD: Yeah. I will give two references in that respect.

MEMBER STETKAR: No. No. I just asked you whether you extrapolated linearly or not. You

said, yes, you did.

CHAIRMAN RAY: Yes, you did, but you will allow me to say --

MEMBER STETKAR: That's fine.

CHAIRMAN RAY: -- why I said what I did, which was that it -- when I asked the question, did it take into account increased rate of sea level rise, which is contrary to the answer he gave you, I understood him to say "yes." So, I want to explore that a little further.

Say it again.

MR. SAMAD: If I may, like staff asked this question and we have two responses to the RAIs. And the RAI numbers I can give is 245-3 and 245-5. And we explain the different extrapolation methods, linear and nonlinear extrapolation methods that we explore in defining the sea level rise projection.

And then we use the linear extrapolation method to defining the regs, but then again I said that our one foot is a nominal increase which is based off 0.8 foot of sea level rising in 100 year. So, we use the one foot as a nominal for 60-year period.

MEMBER RICCARDELLA: So, you'd normally get a factor of two margins that will --

MR. SAMAD: Yes. Exactly. It's a factor of two.

MEMBER RICCARDELLA: What would, you know, if that were off significantly, say it was, you know, three feet instead of one feet, how would that affect your hydrology evaluation?

MR. SAMAD: We have -- we have margins in defining each one of the component that contributes to the pro maximum storm surge height.

One part is like obviously (indiscernible) is at 26 feet (indiscernible), which is 1.2 feet higher than the pro maximum storm surge of 24.8 feet. So, we have 1.2 feet margin in there.

MEMBER RICCARDELLA: Yeah.

MR. SAMAD: Also, in estimating the 10 percent exceedance high spring tide, the -- if we use the (indiscernible) tide data, which is recommended (indiscernible), we come up with an elevation of 1.43 feet (indiscernible). But then an older document, Reg Guide 1.59, come up with values close to the site to be 2.6 feet. And we use 2.6 feet as conservative. So, which is again about 1.2 feet of margin there.

MEMBER RICCARDELLA: Well, the 2.6 feet was for what?

MR. SAMAD: 2.6 feet is for the same 10 percent exceedance high spring tide which we can obtain from Reg Guide 1.59. They have (indiscernible) data given in Reg Guide 1.59. So, that is again 1.2 feet of margin in there. And in addition to that, we have this one foot of sea level rise.

CHAIRMAN RAY: And you feel this is addressed in the RAI responses that you referenced to us?

MR. SAMAD: RAI response is purely for the assessment of the sea level rise.

CHAIRMAN RAY: Okay. Not the high spring tide. Okay.

MR. SAMAD: Yeah. But we explain this in the COLA.

MEMBER RICCARDELLA: You know, I would assume that if the sea level is changing significantly different than what you assumed, that it would be a long-term process that you'd be observing and you could make some changes, right --

MR. SAMAD: Of course.

MEMBER RICCARDELLA: -- to accommodate it?

CHAIRMAN RAY: Well, that's -- yeah.

I'm just trying to get to the data and the basis of the --

MEMBER RICCARDELLA: I understand.

CHAIRMAN RAY: -- data, not what if the data proved not to be wrong. That's perhaps another question.

All right. Any other questions on this topic? Again, I just want to get us so we're not floundering around relative to the basis for the sea level rise projection. We have that now, I think, adequately addressed.

And the other matter, Steve, we'll address at some later time today about the --

MR. FRANZONE: Yes, sir.

CHAIRMAN RAY: I did ask the applicant to talk about Charlie's concern with the detection of an undiluted discharge of liquid rad waste.

Okay. With all of that now having been said, please proceed with the --

MR. FRANZONE: Okay. So, Section 2.5 we'll discuss now.

MR. RIZZO: Good morning. My name is Paul Rizzo and responsible for the foundation engineering for the project.

The first slide -- can you move on a

little bit there, Steve? Specifically, the column of topics on the left side of the slide starting with "site-specific geology investigations," is what I'm going to speak to. The column on the right side, my colleagues, Jim and his friends, will be addressing all of those topics.

The site-specific evaluations looked at the soil profile and the rock profile beneath the site. They were used to determine the foundation arrangement for the project and to perform a number of standard analyses that we do for foundation design.

We spent a fair amount of time and effort in evaluating the potential for karst, development to the site over the life of the plant, and we have developed some -- a program of grouting for a number of reasons that are somewhat due to remediation to the site. That's a term we want to use.

The next slide, very briefly, is the geologic profile. Can we go to the next slide? This is a horizontal-layered site. See at the very top there's a layer of muck and peat, fairly difficult to even walk on when the water is high. Water level is basically at the ground surface a

good bit of the time.

It's underlined by a couple of limestone formations, both Pleistocene in age, a Miami limestone and a Key Largo limestone. And those are underlined by the Fort Thompson, which is also a limestone with moldic porosity, meaning that some of the shells have made up the limestone of this up here.

Beneath that are a couple of very dense sand layers, the upper Tamiami and lower Tamiami. And below that is the Peace River. The Peace River is up -- mid to upper Miocene, which means it's 25 million years or thereabouts.

So, as you come up the sequence, you go 25 million, 10 million, a million, two million up to the ground surface, which is the last, probably, 10 to 20,000 years old.

Now, the next slide illustrates very crudely and quickly the foundation arrangement we have selected for this site. I want to use this piece of rock core right here.

This is a piece of rock core that is taken from the Key Largo limestone. You'll note that's about elevation minus 30 below grade. We selected this formation as our primary founding

media.

You can see -- you can make a couple observations about this and I can pass it around if you would like. It's a typical limestone developed in a marine environment. It has evidence of what we call vugs or pores -- holes in it, for lack of a better word, which in a real serious karsting environment, not what we have here, but in other parts of the world, those eventually dissolve and become caves in some situations around the world such as in Slovenia and parts of South America. Even in the US, eastern United States.

If you'll look at this core carefully, you'll notice something a little bit different. And that is that the voids, for example, here, there is precipitate, meaning that these voids are at a stage where they're filling up with precipitate, not dissolving. The cycle is reversed, in other words.

I'll pass this around and this is the media that we are going to found our plant on at depth. Now, let me explain a little bit how that's going to be accomplished.

You'll see on the slide, that the Key Largo starts at about elevation minus 32, 33. So, we are going to make an excavation down to that

bright blue zone and we're going to come back up with concrete to the bottom of the design elevation for the AP1000 base mat.

The AP1000 base mat is founded basically about 41 feet below final plant grade. Which in this case, if final plant grade is determined from the -- flooding analysis is about 25 and a half, the foundation for the base of the base mat is at minus 16.

So, and that then determines the thickness of the concrete fill that we will place so that we are eventually bearing on this formation, the Key Largo. Let me explain a little bit about how that's done, very quickly, from a -- from a construction perspective.

We go out to the site, and the site is currently about zero, minus one, plus one, with muck on it. We go to the site and we construct what's called a diaphragm wall, a structural diaphragm wall. That's the -- I need a pointer here, Steve.

Okay. That encircles the site. It's a vertical slot. It's probably about a meter wide. And we do that with a vertical excavator called a grab. There are other means of doing this, but this lays out a grab. We go down vertically.

We have to maintain the hole, the slot so it won't cave on us. So, we use what's called a bentonite slurry. The same kind of slurry that's used to drill a deep well for gas or oil or, in this case, an injection well.

You can use a bentonite slurry, and that keeps the hole -- the slot open. Or in the case of a well, the well sides open and it forms a little bit of a filter cake on the sides. And its density is a little bit greater than water, so it keeps the hole open.

We then insert a reinforcing steel cage 10 feet wide, perhaps, down that slot. We go down to the bottom and we put concrete -- pump concrete at the bottom, which displaces the slurry upward and we create a concrete wall. I call it a "bathtub" around the excavation.

And then we start making, then, the one other aspect of it. We have a bathtub, but there's no bottom. The bottom is very pervious, as you can see from this. So, then we have to grout.

Grout is a material of cement and water and some additives like bentonite. That will fill these kind of voids and make that formation basically impervious.

The -- we grout two zones. We have a grouted zone in the light blue and we have an extended -- in this case, extended grouted zone below that into the Fort Thompson.

So, now I've got the wall around my excavation, I have a bottom of my bathtub with a grouted rock. Now, I can make an excavation into dry. And as I go down, I pump the water out of the bathtub. So, when I'm all finished, I've got a dry hole and I can now construct the AP1000 base mat.

The wall stands vertically, not on its own. We have to have anchors back into the formations to hold it as we go down. When we're all finished, we come back up with the engineered fill and we raise the grade up to 25 as we're coming up.

So, I wind up with a base mat (indiscernible) at elevation minus 16, 41 feet below the standard design of the AP1000 resting on a concrete fill, which, in turn, rests on two grouted zones, the bright blue and the pale blue.

CHAIRMAN RAY: Could you explain a little how you do the grout?

MR. RIZZO: Yes, sir. I'm going to spend a few minutes on that after the next three slides. And I'm going to diverge for a moment and

tell you the results of three standard analyses that we do independent of whether it's a limestone site or a soil site or whatever. We do a settlement analysis, we do a bearing capacity analysis, we do a liquefaction analysis. Three standard calculations.

The calculations vary depending on the soils' conditions, of course, but those three standard types of calculations are done for every foundation design.

Next slide. The first one is a settlement analysis. We do this a couple different ways using a finite element analysis, or, in my case, we go back and move by hand, because that's the way I learned to do it some 40-50 years ago. So, we do it both ways. I don't always trust the computer programs.

(Laughter.)

MR. RIZZO: That's a fact. I don't. And my guys will tell me that. And we meet the DCD criteria for the AP1000, which are very well spelled out in their plant parameter envelope.

We do a bearing capacity analysis on the next slide. Bearing capacity means the settlement is one criteria, but you don't want the building to fail under static or dynamic conditions.

And a bearing capacity failure means that the structure goes like this. You've seen classic pictures in Japan of buildings on their side after an earthquake. That's a bearing capacity analysis. We do that a couple different ways, also, by hand and by several different programs.

What you see here, those aisles are what we call the failure surface on which the soil materials or rock materials fail and the building comes to rotate around. We meet the AP1000 criteria for bearing capacity without any problem, both static and dynamic.

The third is the liquefaction analysis. The -- you don't get liquefaction, of course, in rock, but what about those sand layers underneath the rock?

So, we addressed those. We did it three different ways with what we call a standard penetration test, cone penetration test, and shear wave velocity data.

We didn't take any credit for the age of the formations. Age has been shown by the profession to be a factor in liquefaction analysis. And the older the material is, the unlikely it is to liquify. In fact, we've never seen liquefaction in

Miocene-age materials.

Over-consolidation means that that material at one time was compressed. We don't take any credit for that. And we don't take any credit for the fact that that -- the two sand formations have some degree of cementation associated with them.

We used -- for the liquefaction analysis, of course you have to have an earthquake, and we used the worst magnitude of the series of events that my friend Jim here determined could occur.

What's "magnitude" mean? Well, "magnitude" means that the higher the magnitude, the more cycles of ground motion you have. The higher -- the more cycles of ground motion you have, the more potential for liquefaction because you're shaking the soil. We used the worst-case magnitude.

And for ground motion input, the maximum rise of ground motion, in this case, maximum shaking horizontal, we used 0.1g. Jim's going to tell you that the design -- the seismic design basis for this site is closer to 0.06g. But because of the reg guides and the regulations, we use 0.1g for this site. We concluded liquefaction is not a problem

with the site.

So, I've dealt with the bearing capacity, I've dealt with the settlement and dealt with liquefaction and all are fine. The only geologic hazards that I have not addressed yet, which is on everybody's mind, the elephant in the room, so to speak, is the karst. How do we deal with that?

Next slide -- no, that's all right. Leave it there. We postulate, for example, serious karst deformation. We have none. Why we consider it serious, we have evidence like this in these vugs and these voids. We don't have any caves or sinkholes or springs or paleo-collapse features on the site.

We do have, and you've seen it on the next slide, I think, some features shown in black. Steve will point them out to you. Those are surface depressions which, to many people, are evidence of karst development. And to some degree they are, yes.

They are highly-vegetated areas. You can't even access them, really. That would be suggestive of something happening down below. And, in fact, they are -- they are surface features where

surface water accumulates and enters into the ground probably through a fracture down to the groundwater level or to a deeper formation. So, that is the best suggestive evidence of any karst on the area and that's pretty minimal.

So, we drilled borings into those features, and you see them on the right side right under Unit 6, on an inclined basis. Why inclined?

Well, first off, if you have vertical fractures, you're not going to pick it up with a vertical boring. You're going to get the fracture like that, the boring inclined.

Secondly, we didn't know what the fractures are underneath that depression, those depressions, if they were vertical, inclined or whatever.

And we couldn't put a drill rig in there because of the vegetation, so we drilled two horizontal -- or several, not two, several inclined borings into those features to determine if the degree of solution activity is greater or less than in the areas under the plant that I call the "Key Largo" where this was taken from, and there is some suggestion that there is more vugs, more voids in those areas. But, again, they're relatively small.

Let me just talk about how we know that. We use the terminology "tool drop" to determine if we have evidence of voids or soft shells or whatever when we're drilling a boring. A tool drop occurs when a drill rig or a driller is drilling a hole, a boring, either inclined or vertical, and, for example, if he's doing a coring operation or he's developing getting a core like this and he's pulling on it, he's holding his lever, very steadily pulling that and pushing down the tools, coring as he's going, and all of a sudden it goes like this, implying that something happened there.

It could be open void, it could be a soft zone, whatever, but It's classified in our terminology as a tool drop.

The same thing if you're doing what we call a standard penetration test sampling where you're counting -- you're dropping a weight on a sampler and you're recording the number of blows per foot to drive that sampler down.

Say you're going one, three, six, eight, eight. All of a sudden, boom, it drops. That's a tool drop in sand. Two different types of drilling record as a tool drop.

Now, you can have tool drops, and you do

have tool drops, on any kind of investigation for -- when drilling, not necessarily limestone sites. You have tool drops for many different reasons. Only one of which can be caused by dissolution of limestone in a limestone layer.

So, we determine what number of tool drops we had and this -- in these vertical borings as well as these inclined borings, and that's on the next slide.

CHAIRMAN RAY: Let me just ask, is this too shallow for reflection surveys?

MR. RIZZO: Yeah. Yes, it is.

CHAIRMAN RAY: Yeah. Okay.

MR. RIZZO: The vertical borings --

CHAIRMAN RAY: I was wondering about that.

MR. RIZZO: -- we have tool drops cumulative from all regions of 0.3 percent of our total core. I should say that if I were drilling on a non-limestone site, I would expect tool drops to be somewhere in the range of 0.2, maybe 0.3 percent. Not very much.

Individual tool drops 0.4 feet to four feet on a site. Four feet is a little bit more than I would expect on a normal site.

Individual tool drops within the Unit 6 and 7 footprints were limited to about a foot and a half. A foot and a half is borderline whether it's significant or not.

Now, in these inclined borings, which were drilled underneath those depressions, you see the tool drops a little bit higher, four percent. Cumulative 15 foot out of a total of 300 plus feet. Tool drops on the order up to two and a half feet, so -- but these are on the site. Beneath our units, the worst situation we had was one and a half feet.

We consider the tool drops to be -- they certainly are indicative of some karstic -- well, I'm going to say dissolution activity. They're not a major issue.

We, nevertheless, proceeded to develop a foundation scheme, and you've seen this. This is a repeat of the slide before where we have those two grouted zones.

Well, conveniently, or inconveniently, depending on your perspective, we have to grout those two zones to create the bathtub or we'll never get that excavation open. The water would simply flow up into the excavation.

So, we have a -- we have two grouted

zones which have the secondary purpose of filling up these or these if they exist underneath the site.

So, the grouting program begins with a grout take test program to determine the techniques to be used for grouting and we know what we're going to do, but we have to finalize all the details of it.

One of the important issues is what's closure? When do you stop grouting? You pump cement and water mixture into the grout under pressure. Does it go forever? When do you stop? Those are called closure criteria.

Those are determined by a test program where you vary the pressure and you monitor the take and you vary the mix. And the mix has certain constituents to it such as viscosities measured, cohesive nature of the grout and so forth.

You don't want the grout -- you don't want to grout the world, so to speak. So, you have the confinement of the diaphragm wall besides the bathtub, but you still have to pump grout in to fill those voids.

So, how do we do this? We have -- we start with a grid of borings, in our case, on a 20-foot spacing. Now, for the primary grout zone up on

top, we drilled borings on the 20-foot spacing and we grout under pressure pumping in cement and water, bentonite mixture with some additives all under a computerized control system that monitors the pressure and the volume, which allows us to calculate travel distance, the take we're getting and if we're fracking the rock or not.

In the case of the upper light blue area -- dark blue area -- bright blue, we're going to split-space those holes to 10 feet. After we get the 20-foot holes done, we go in between and drill again to do 10 foot. That way we're able to see how much to verify the results of our grout take test program and travel distance of grout.

So, as shown on the -- your left, the grouted zone is from elevation minus 35 to minus 60. Our primary hole is on 20-foot spacing. And secondary hole is on 10-foot spacing.

If during the program we were to find that the takes in the secondary holes were still very significant in excess of what our test program would indicate, we go to tertiary spacing, split-space those again down to five. And then in a very unusual situation, perhaps certain locations, we'd drill them split-spacing again with Quaternary

holes. So, you go from 20 to 10. And if necessary, five and two and a half feet.

When we get done with that, we will have grouted everything in that extended grouted zone with anything significant from a structural point of view.

The extended zone down below the primary, we drill those only on 20-foot spacing. And we will have determined in our take test -- grout take test program what the take should be. And if necessary, we'll put secondary holes on 10-foot spacing.

Well, that suggests that if you only put 20-foot spacing in the holes, you could have a void 20-foot diameter in that material that you didn't fill because you didn't have a boring close enough to it.

So, then we went to the analytics of the situation. We took -- did analysis that shows the -- we put a 20-foot diameter void the full width of an AP1000 base mat at 156 feet wide, 20-foot diameter underneath that plant at an elevation at the top of the extended grout zone and we were able to show that the base mat is not impugned by this featured.

So, the grout take -- the grout program is subject to an ITAAC. A very detailed ITAAC, in fact, as is the grout take test program, to be done before we even do production grouting.

So, the production grouting is basically done before we even start construction of the base mat, because we have to use that grouting zone as the bottom of the bathtub where we come up and we backfill it, the excavation, and we're done.

Okay. I hope that answered your questions. Thank you.

MEMBER BLEY: Sure did. Thanks.

CHAIRMAN RAY: Thank you.

Any other questions on this piece? If not, please proceed.

MR. MARRONE: All right. Good morning. My name is Jim Marrone. I'm a seismologist at Bechtel Corporation.

I'll be speaking about the geology and tectonics and seismicity of the site region, discussing geologic hazards, development of the site-specific ground motion response spectra at the end of this presentation.

If you have any questions that are tangential to my specific expertise, I have out in

the crowd there geologists and geotechnical engineers which will help me. I've also got some folks on line as well.

The Florida peninsula is the emergent portion of the mostly submerged Florida platform which itself is part of the larger Florida Bahama platform. These platforms represent a massive, thick -- about 20,000 feet -- shallow water carbonate sedimentary province deposited over crystalline basement rocks. The Florida peninsula, as well as the platforms, exhibit a low level of earthquake activity.

In contrast, just inside the 200-mile site region to the south is the northern part of Cuba with its notably higher rate of seismicity, which is indicative of a complex tectonic history in the region.

With lifting of the giant continent of Pangaea beginning in the Mesozoic about 200 million years ago and subsequent opening of the Atlantic Ocean and Gulf of Mexico, collisional subduction ensued with the North American plate thrusting southward beneath the Caribbean plate, the boundary being located at the northern coast of Cuba.

Cuba shows the faulting and deformed

metamorphic volcanic and carbonate rocks from this Orogenic period. After the Eocene, which is about 34 million years ago, this North American/Caribbean plate boundary shifted southward from the north coast of Cuba to the south of Cuba where the current plate boundary is active today.

So, at this time, major tectonic activity ended in the site region and the Florida peninsula itself has been a stable carbonate platform since.

Next slide, please. This figure shows the 200-mile site region including the large submerged Florida and Bahama platforms and northern Cuba. We can see the very low level of seismicity of peninsula Florida as compared to Cuba to the south.

The largest earthquake in the 200-mile radius of peninsula Florida occurred in July of 1930 with the body wave magnitude of 3.7. The largest earthquake cataloged in Cuba occurred in 1914 with a moment magnitude of 6.29. Occurred offshore of northeastern Cuba.

Next slide, please. The tectonic history of the region left its imprint on numerous geologic structures in the region. This slide

indicates several of the tectonic structures that were investigated as discussed in the FSAR.

In this figure, faults are shown in red, and folds are shown in purple. These features were evaluated for their impact not only as possible seismic sources for future earthquakes, but also closer to the site to assess the potential for surface deformation in the site vicinity.

In evaluating geological, geophysical, seismological and bore hole data, it was concluded that most of these features in the site region do not appear active or capable of generating future earthquakes that would impact the site.

Where this conclusion was less defensible, hazard sensitivity calculations were run. And two examples of those -- or the two that we looked at are Walkers Cay -- if you could point, there it is right there at about 200 miles distance -- and the Santaren anticline. Thank you.

Both of these were not found to contribute significantly to the seismic hazard at the site as a result of our sensitivity calculations.

Tectonic features within the site vicinity that is 25 miles, were not found to result

in surface deformation. Not shown in this particular figure are several active or potentially active faults within Cuba itself which were, as well, investigated for seismogenesis.

Note especially in this figure the Nortecubana fault system, which is the ancestral plate boundary along which subduction was occurring before the Eocene and before the plate boundary transferred southward.

Next slide, please. In this zoomed-out and more southern view of major tectonic features, we focus on the North America-Caribbean plate boundary located about 400 to 800 miles from the site.

For reference, we again see the Nortecubana fault system -- thank you -- as the pre-Eocene ancestral plate boundary along the north-northeast coast of Cuba.

Marking the current plate boundary is a series of several very seismically active faults that bound either side of the approximately east-west trending Cayman trough seen toward the middle of the slide. These faults, indicated in red, may have slip rates on the order of 10 to 20 millimeters per year.

Next slide, please.

CHAIRMAN RAY: You use "slip rate." This is a pressed fault, isn't it?

MR. MARRONE: No, these are actually (indiscernible) faults.

CHAIRMAN RAY: The movement, therefore, is -- which side of the fault is going which direction?

MR. MARRONE: The bottom half, if you will, of the -- or the top portion of the Caribbean plate right where the mouse is located --

CHAIRMAN RAY: Right.

MR. MARRONE: -- is moving laterally to the east.

CHAIRMAN RAY: I see. To the --

MR. MARRONE: To the right.

CHAIRMAN RAY: Yeah. Okay. Because you're facing the other way.

(Laughter.)

CHAIRMAN RAY: You confused me, but that's my fault.

MR. MARRONE: That way. Yeah.

CHAIRMAN RAY: Yeah. All right.

MR. MARRONE: Yes. Thank you. This is a similar view to the previous slide. Again, Cuba

shows a low to moderate level of seismicity and the plate boundary shows a distinctive high level of activity.

Given the relative quiet seismic setting of Florida and near platforms, it was apparent we needed to consider both Cuba and the distant plate boundary faults as possible contributors to the seismic hazard at the site given their elevated level of seismic activity despite their distance to the project site.

Nine faults along the plate boundary shown here as colored lines were modeled as seismic sources.

MEMBER BLEY: Just a quick question.

MR. MARRONE: Sure.

MEMBER BLEY: Everything on this picture are very small earthquakes. Two pictures back there were some pretty big ones, but that was from before the plate motion changed; is that right, or -- go two back. There. You got pretty big ones right on the north side of Cuba by comparison to the picture we were just looking at.

MR. MARRONE: And I apologize. These figures were produced in a different fashion and their scaling is not consistent between --

MEMBER BLEY: Well, it's not consistent, but it's not that far off, if I look at the two.

MR. MARRONE: Well, if you look at --

MEMBER BLEY: Six.

MR. MARRONE: -- Slide 23 --

MEMBER BLEY: Oh, yeah. No, you're right. Okay.

MR. MARRONE: Okay.

MEMBER BLEY: Yeah. I withdraw.

MR. MARRONE: That's okay.

I spoke about the nine faults along the plate boundary that were modeled, the seismic sources. A single homogenous area source encompassing Cuba and near offshore seismicity was modeled shown here in the light purple toward the middle of the slide.

In a moment, I will address the adequacy for that model for Cuba to capture its contribution to the seismic hazard at the site.

Next slide, please. Units 6 and 7 lie on the stable Florida carbonate platform. The geology within the site area is dominated by flat planar bedding in late Pleistocene and older units.

There are no traceable tectonic lineaments. There is no evidence of capable or

Quaternary tectonic surface deformation within the 25-mile radius site vicinity.

The only geologic hazard identified in the site area is potential surface deformation related to carbonate dissolution, as we talked about earlier.

As presented earlier, the potential for dissolution at the site for these minor features are accounted for in foundation design.

MEMBER KIRCHNER: May I ask a question?

MR. MARRONE: Certainly.

MEMBER KIRCHNER: When is the time frame for this dissolution process in terms of the plant lifetime and such? I mean, how rapidly could this --

MR. MARRONE: Do these form?

MEMBER KIRCHNER: No, I was coming back to the karst.

MR. MARRONE: Okay.

MR. RIZZO: At the moment, the only area where we have dissolution activity is water seeping -- surface water seeping down through those vegetated areas that I pointed out where I drilled these inclined borings.

Everywhere else we have (indiscernible)

water. So, we actually have precipitation going on rather than dissolution activity. So, that's been going on now certainly a million years you have the solution activity underway.

MEMBER KIRCHNER: And then now in geologic time, this carbonate dissolution that you're referring to, what's the time scale of that?

MR. RIZZO: We're talking the same.

MEMBER KIRCHNER: The same?

MR. RIZZO: The same. Yeah.

MEMBER BALLINGER: So, what you're saying is that once you've characterized the site, there's the likelihood of something happening over the life of the site. All of a sudden, you know --

MR. RIZZO: Right. Disappears.

MEMBER BALLINGER: -- a phone booth disappears or something like that.

MR. RIZZO: Right. Right.

MEMBER BALLINGER: That's not likely to happen.

MR. RIZZO: That's right.

MEMBER BALLINGER: Thank you.

MEMBER KIRCHNER: Thank you.

MR. MARRONE: So, based on the review and updating of the geological, seismological,

geophysical and geotechnical data for the site, nothing was identified that precludes the safe operation of the facilities.

Next slide, please. As part of the usual ESP or COLA site investigations in central and eastern United States, or CEUS, we started with the Reg Guide 1.208, accepted seismic source models and databases developed by the EPRI Seismicity Owners Group, or EPRI-SOG, in the mid to late 1980s.

Recognizing the need to consider Cuba and Caribbean for seismic sources and assessing the seismic vibratory ground motion hazard, and knowing, of course, that the EPRI-SOG did not cover those regions, we developed a project catalog in two phases.

The first phase was using or starting with the EPRI-SOG catalog through 1984 and updating that catalog which covered primarily central and eastern US. And then a Phase 2 catalog covering Cuba and the Caribbean regions.

The objective was to develop catalogs covering all earthquakes in the entire area in which we were considering seismic sources of magnitude three or greater.

Next slide, please. Shown here is a

plot of both the Phase 1 to the north covering central and eastern US, and Phase 2, the catalogs covering Cuba and Caribbean region.

We had to develop those catalogs distinctly from one another because of the characterization of seismic sources used as a different type of magnitude. The CEUS SSC seismic sources from EPRI-SOG used a base body wave magnitude. And we didn't want to go and convert all of those to a more moment magnitude which is used currently.

In the development of the catalog for the Cuban/Caribbean region, we used a moment magnitude there. And there are conversion relationships between these.

Next slide, please. Shown here is a plot of the 1980s -- mid to late 1980s EPRI-SOG seismic sources, the various colored seismic source polygons from six earth science teams, or ESTs.

Per Reg Guide 1.208, the EPRI-SOG models and databases are acceptable starting points, but need to be reviewed for any update. And that's what we did.

And in terms of the seismicity from the previous slide, the original EPRI-SOG Phase 1

catalog, if you will, only went through 1984 and we updated that through 2008 at the time of our analyses.

With regard to the seismic sources from EPRI-SOG, there are, as I mentioned, six complete seismic source models comprising the EPRI-SOG seismic source characterization and they needed modification including filling in seismic activity rate values left empty in the Gulf of Mexico in the original EPRI-SOG modeling.

We also had to supplement the EPRI-SOG seismic sources for the 200-mile radius around our site that had not been covered by the original EPRI-SOG seismic sources.

And then given the updated catalog, we needed to consider updating, and did, the maximum magnitude, or Mmax, for each of the sources of the CEUS.

Additional updates included the adoption of the updated Charleston Seismic Source, UCSS, initially developed for the Vogtle SSAR. From post EPRI-SOG studies, it was determined that the recurrence rate of the Charleston earthquake had been underestimated in the EPRI-SOG modeling. This was resolved with the UCSS model. As previously

discussed, we developed Cuba and Caribbean seismic sources as well.

Next slide, please. This is just a word summary of what I just spoke to on the previous slide.

We've seen this slide earlier, the North America/Caribbean plate boundary faults are modeled as shown in the colored faults again, estimates of slip rates, which translate into the number of earthquakes per year, and maximum magnitudes were made based on literature review.

Cuba, as I mentioned before, is modeled as a single, homogeneous seismic source. We use the Phase 2 seismicity catalog to determine seismic activity rate for that.

As discussed earlier, there are faults mapped throughout Cuba. And as I mentioned, these are discussed in detail in the FSAR.

Some literature studies indicate that several of these faults are active or potentially active. However, uncertainties in fault location and/or locations of historical earthquakes make it generally difficult to associate earthquakes -- specific earthquakes with specific faults.

Further, there is not slip information

or specific activity rate information/slip information on these faults to be able to model them. Nevertheless, we performed a Cuba hazard sensitivity study for alternative modeling of Cuba.

We considered alternate area models, we subdivided the Cuba single model that we had used in the FSAR into six subareas to develop more -- to capture more of the heterogeneity of the distribution of earthquakes throughout that model.

We also considered fault models as best we could using mapped faults that we know of and assigning very wide-range slip rates on these. And the initial modeling that we did with that with very wide range of slip rates ended up with a seismic moment rate, basically the cumulative energy that all the earthquakes over time per year is being released, that seismic moment rate from our initial modeling of those faults came up over three times the rate of seismicity that we see in the earthquake catalog.

So, we refer to that as the FF model, the full fault model. We didn't consider that. That was a very reasonable model to have something that was predicting earthquakes at a much higher rate than what we actually saw in the earthquake

record. So, we scaled the activity rate of those faults based on the seismic moment rate from the catalog itself. That's referred to as the scaled fault model, or SF.

So, these alternate area models, these fault models were considered in this sensitivity study, their combination was considered, and the result was that our single area zone indicated in purple here adequately captures the seismic hazard at the site.

CHAIRMAN RAY: Is -- was there any review of, say, offshore surveys done by oil companies, that sort of thing? Because what you're referring to here is all, sounds like, based on data that has accumulated over historic time.

And I'm just wondering do we have any assurance that there aren't faults that are closer to the site that would be detected by refraction as the oil companies do, for example, routinely?

MR. MARRONE: Certainly. If you step back to -- could you -- yes, that slide right there. In the 200-mile radius, this figure indicates numerous features that we looked at. Some of these -- some of them offshore and developed from -- I don't know if it was oil industry information or

not, but it is seismic reflection to look at different structures and the ages of the strata.

CHAIRMAN RAY: So, there are data and they were -- in one way or another they have been reflected in the (indiscernible)?

MR. MARRONE: Yes.

CHAIRMAN RAY: Thank you, Jim. I apologize to our record-keeper over there. I don't know. My mind is not focused on turning the microphone on.

MR. HOGAN: Hi. I'm Phil Hogan with Fugro Consultants. I just wanted to comment on the seismic reflection data that we looked at in the straits of Florida and the Santaren Channel.

We reviewed high resolution, deep penetration, as well as other sources of seismic data that are publicly available. Most of which were collected for the oil industry. We reviewed over 30 seismic lines and presented those in a working meeting at the NRC here on May 21st, 2015. Thank you.

CHAIRMAN RAY: That responds very well to what I was interested in. Thank you.

MR. MARRONE: Thank you, Phil. Okay. I think we're on Slide 30. Yes. As I had indicated,

we have seismic source models both covering the central and eastern US, as well as Cuba and Caribbean.

For a seismic hazard evaluation, you have to bring the ground motions from where the earthquakes are occurring to your site. So, you have to have a ground motion model that will take that modeled event at that earthquake source and attenuate that ground motion to your site. So, that's what a ground motion model is.

For the CEUS, the original EPRI-SOG had its own grand motion model, but that was replaced as has been done in many of the ESP and COLA projects in more recent time, with EPRI 2004, 2006 ground motion model.

For Cuban/Caribbean sources, the -- as you could tell, the tectonics, the geology is very different for Cuban/Caribbean than it is for central and eastern US. And we need to consider a different ground motion model that will attenuate the ground motions from the Cuba and the Caribbean sources to the project site.

There is no appropriate ground motion model that a specific -- for this application when we look through the literature. So, we had to

develop one ourselves.

One that was available as a starting point, at least, was one that is developed and published in 2005 for PSHA in Puerto Rico. It was not suitable for our site as is because the range of magnitudes was not sufficient. And particularly, the range of distances for applicability for this site, which was quite a distance, was not applicable.

The Puerto Rico model was also developed for soft rock site conditions, and we needed, as I will discuss in a moment, very hard rock site conditions.

So, we started with some of the source parameters from the Puerto Rico model that had been published and developed our own, as it's called, stochastic modeling to develop artificial ground motion data that we could then analyze and develop our own ground motion models from.

We compared these new, I'll call them, Caribbean ground motion models with a few recordings that are available. I should step back and say that ground motion modelers really love data. In the western United States, there's lots of earthquake data and you can model directly from the empirical

data itself.

In locations like central and eastern United States or in Cuban/Caribbean, if you will, even though there's a lot of earthquakes there, there aren't a lot of recordings of those earthquakes. You don't have enough data. So, the ground motion modelers for areas like this have to use more theoretical methodologies as was done for Puerto Rico, to develop the models as is being done right now for central and eastern United States.

So, that's the approach that was used here. But if you've got data available, you want to try to compare. Even though it's not enough to develop the model, how does it compare to what's available.

So, we had five earthquakes that occurred around the Caribbean that we have recordings from. So, we looked at those to see how their -- the recorded motions from their magnitude and distance compared to our model that we developed.

We also in response to an RAI, but just for prudence anyway, is compared the CEUS model that we were using for the CEUS seismic sources, we compared that model with this new Caribbean model,

if you will. And I'll show you the results of that.

We have in the end with this development of this ground motion model, we had six ground motion attenuation experts. We asked them to review this model to see if they had any comments on it to get some feedback, and they all felt that the Caribbean model that we had developed was acceptable for this application.

Next slide, please.

MEMBER SKILLMAN: Jim, I wanted to ask you this: In developing this model, you've got St. Lucy not so far away and Crystal River not so far away. Was there any use of data for those two plants? And of course the Ledy site is really not that far away either.

So, is there any synergism from those previous efforts for seismic for those plants? There are three; St. Lucy, Crystal Rive and Ledy.

MR. MARRONE: I could be corrected on --

MEMBER STETKAR: What you've presented is a custom model for this site. I understand why one would do that.

MR. MARRONE: Okay.

MEMBER STETKAR: But I'm really asking, isn't there more information available to you?

MR. MARRONE: Let me rephrase when I said we developed it for this site. We actually developed it for -- more for the specific Cuban/Caribbean sources for attenuation from ground motions from there to our site.

So, any ground motion -- unless St. Lucy or Crystal River also wanted or had seismic sources from Cuban/Caribbean, then there wouldn't be any synergism there, if you will. This was to cover these ray paths of earthquakes coming from Cuba and Caribbean. That's the site-specific element that I mentioned.

MEMBER STETKAR: Okay. Thank you.

MEMBER RICCARDELLA: There's also some, I guess, site-specific seismic design spectrum for the earlier Turkey Point units, right, that you could have -- it would be interesting to see how your new ground motion response spectra compares to that. And I'm sure they're probably updating that as part of the (indiscernible).

MR. MARRONE: For the existing sites -- oh.

We haven't made any comparisons for the spectra, which I'll show you, which we developed. We haven't made specific comparisons to the existing design

basis for -- or the design basis for the existing plants. We haven't done that.

MEMBER STETKAR: Haven't the existing plants had to update their seismic hazard information in response to the recent -- well, recent four-years-ago order?

MR. MARRONE: Sure.

MEMBER STETKAR: So, why didn't you compare to them since it's supposedly developed according to the current state of the practice?

MR. MARRONE: We have not made an explicit comparison. But at the end of my presentation, I will be showing you what the -- the sensitivity study that we did comparing what we got with regard to the FSAR results using updated EPRI-SOG, if you will, in comparison to using the same seismic source model that was used for that Fukushima work for the existing plant site.

MEMBER STETKAR: Well, I guess -- I'm hoping that the staff made that comparison and we'll see it, because that's what I would expect the staff to do anyway. So, maybe we'll wait to see what they did.

MR. MARRONE: Well, one of the notable differences is that when the Fukushima work was done

-- I'll call it "Fukushima work," it was -- the direction was to use what I will be talking about later as the ground motion -- the seismic source model from EPRI et al. 2012. And to use that for these Fukushima evaluations.

There was no indication in there to supplement that by any other sources such as Cuba and Caribbean. So, they would not have been included in that, as far as I know.

And as I will show you, the Cuban/Caribbean sources actually do contribute notably to the site.

So, this slide here, back to the ground motion model, shows you a couple examples of attenuation relation results. On the right-hand side, these plots are ground motion in the y axis as a function of distance. Along the x axis and the top plot is for one hertz. The bottom plot is for two and a half hertz.

The distance range there of plotting is from 200 to 1500 kilometers, which was the range of use for the PSHA.

The ground -- the new ground motion models, I should say, are the red curves. And as I mentioned, we compared them to five recordings that

were available. One of these are shown in this plot as the black symbols you have on the left-hand side. The map view of the vent, which is the red star. And the recording stations throughout the Caribbean and in peninsula Florida, in this case, shown as the black triangles.

They're shown again as the black symbols in the plots on the right-hand side and you can see that our developed model -- we had a range of models to consider the uncertainties. So, you'll see several red curves there by models that we had. And they generally fall slightly higher than the observed ground motions.

The blue and the green are the attenuation relationships from the EPRI 2004 ground motion model used for the CEUS seismic sources. The blue are the mid-continent models that were actually used for the CEUS seismic sources for this application.

They're referred to as mid-continent. They come in higher than the green models which are appropriate for seismic sources of the Gulf of Mexico. So, we're right in between.

MEMBER BALLINGER: This event that you're talking about, was that the most recent

Haitian earthquake that occurred in Haiti?

MR. MARRONE: This -- right. I don't -- I don't believe -- this occurred in 2007. So, no, it's not.

MEMBER BALLINGER: Okay.

MR. MARRONE: Right. It was 2010. I have a list in the SAR of the events that we actually used, the five events. Again, it's a function of not only -- there are obviously numerous earthquakes along that Caribbean plate boundary. How many of those are actually reported with a distribution of stations is not as prevalent to the US. So, we have five to work with, basically.

Okay. Given the sources, the seismic sources, given the ground motion models that we have to work with, we performed the probabilistic seismic hazard analysis.

The reference site conditions are for hard rock that is material in the top -- well, material with a shear-wave velocity of 9200 foot per second, which is very hard. We developed five percent damped response spectral acceleration hazard curves at seven different frequencies. We had their mean and their fractile hazard curves, as you'll see in a moment.

We also performed a deaggregation analysis to determine what are the major contributing sources by magnitude and distance? And you'll see a plot of that as well.

The purpose for developing controlling earthquake magnitudes and distances that is sort of the centroid of magnitude and distance that contributes to a given frequency and a hazard level, was to implement NUREG/CR-6728 approach to a site response analysis.

We needed to, if you will, break apart the hazard -- uniform hazard spectra into high frequency and low frequency portions. And those high frequency and low frequency portions of the uniform hazard spectra are controlled by different magnitudes and distances. So, we need to appreciate that. High frequency is defined as five to 10 hertz. Low frequency is one to two and a half hertz.

Verbally, the results for low frequency, we needed to look at two levels of a hazard that's 10 to the mi nus four and 10 to the minus five as specified in Reg Guide 1.208.

The low frequency at 10 to the minus four hazard level was dominated by the Cuba and

Caribbean sources. At 10 to the minus five, higher ground motion level, was equally dominated by Cuban/Caribbean and Charleston got in there at that point. And then secondarily, finally, the CEUS sources themselves.

For high frequency, the hazard at those two hazard levels was dominated by primarily the local sources.

Next slide, please. Okay. This is an example primarily of hazard curves. And in the lower right-hand corner there are uniform hazard spectra at three hazard levels.

The top left is for PGA. The top right is for 10 hertz. The bottom left is for one hertz. And as I mentioned in the bottom right, you have uniform hazard spectra at 10 to the minus four, 10 to the minus five and 10 to the minus six hazard levels.

As I also mentioned, the 10 to the minus four and 10 to the minus five hazard levels are the ones that are explicitly used in Reg Guide 1.208 for determination of the GMRS, the ground motion response spectra.

Next slide, please. I mentioned to you we did deaggregation analysis to determine the

controlling earthquakes or sources. These are plots of relative contribution as a function of distance and a function of magnitude.

And in the lower left-hand plot, you can see which direction is increasing distance axis. And the other axis, the increasing magnitude axis.

The top row we have the low frequency. This is one to two and a half hertz. In the bottom row, we have high frequency deaggregation, five to 10 hertz.

The left-hand column is for 10 to the minus four, and the right-hand column is for 10 to the minus five.

And you can see in these plots as pointed out in the low frequency, the top row, the Caribbean and Charleston sources are dominant sitting in skyscrapers out there at the large magnitude, large distance.

And in the bottom row, which is the high frequency, you see the smaller magnitude, smaller distance contributors are those that are coming from primarily the CEUS EPRI-SOG sources. And we also highlight there what the controlling magnitudes are.

The M and D values, you can see that you get different M and D, magnitude and distance,

basically the mean values, for the different frequency intervals, low or high, and the different hazard levels.

Next slide, please. I mentioned earlier that for Reg Guide 1.208 we needed to consider separating a uniform hazard spectrum into its high frequency and low frequency components, if you will, or separate subspectra. And those subspectra, high frequency to low frequency spectra then input into the soil, call it, for site response analysis.

And here on the left you see the high frequency and low frequency spectra for 10 to the minus four. And on the right-hand side you see the same high frequency and low frequency spectra at the hazard level of 10 to the minus five.

The green dashed line there in each plot is the low frequency spectra. And then the solid line is the high frequency spectra.

Next slide, please. So, from the previous slide we have developed the in put hard rock motions, remember the PSHA was done for hard rock, and we now have the hard rock response spectra high frequency to low frequency at two hazard levels. Those are input into the rock soil column.

And here we see plots of shear wave

velocity as a function of depth. On the left-hand side we see a shallow profile here from zero to 800 feet. On the right-hand side we see the full column here from zero to 12,000 feet.

The rock input motions again at 9200 foot per second were variously input between 7400 feet and 11,400 feet depths. This plot is indicative of the consideration of uncertainties in that randomization is performed about the best estimate profile. And this was done not only on the soil rock shear wave velocities as shown here, but also on the shear modulus reduction curves and the damping values.

Next slide, please. Thank you. And these are the resulting site-specific ground motion response spectra. On the left-hand side we see the horizontal spectra. The red line is the 10 to the minus five coming out of site response analysis. And the -- I guess this really blue line at the bottom there is the 10 to the minus four. And then applying the Reg Guide 1.208 performance-based methodology in the blue box below, you consider the 10 to the minus four and 10 to the minus five in that algorithm to get the performance-based ground motion response spectra shown in the left-hand side

for horizontal as the green line.

On the right-hand side are the spectra of course running for vertical. We used a Reg Guide 1.60 vertical-to-horizontal ratio, V over H ratio, applied that to each of the 10 to the minus four and 10 to the minus five horizontal spectra and got corresponding 10 to the minus four and 10 to the minus five vertical spectra shown here. And then applied the same Reg Guide 1.208 methodology to get the vertical GMRS.

The results, as indicated earlier, is that the horizontal PGA is about 0.06g. And it indicates that this is a very low seismic hazard site. Thank you.

We were asked, and I discussed this -- mentioned this earlier that subsequent to our development of the GMRS, EPRI and others came out with a new seismic source characterization model for the central and eastern US in 2012. So, what would we have gotten had we used that model for the central and US sources as opposed to our updated EPRI-SOG sources that I presented earlier?

So, we ran a sensitivity, not the whole suite, but ran a sensitivity calculation using the EPRI et al. 2012 CEUS seismic source

characterization model. We extracted out the Cuban/Caribbean sources from our analysis and added them back in so that we could do a total hazard comparison.

The results show that for two and a half hertz and higher, the spectral accelerations from the newer 2012 CEUS SSC model actually come in below what we had developed following our course as I presented earlier.

For lower frequencies, one hertz and lower, spectral accelerations from the newer 2012 CEUS SSC model resulted in a total hazard that was very slightly higher than what we obtained. It's not significant in that exceedance, as you'll see in the next slide.

Here are hazard curves, comparison hazard curves in using both of those CEUS SSC models. On the left-hand side, it's for 10 hertz. On the right-hand side, it's for one hertz. 10 hertz as a proxy for the high frequency that I mentioned earlier, that the solid red line here is from the application where we used the updated EPRI-SOG, and use of the newer 2012 CEUS SSC model is shown by the dashed red line that comes in lower.

MEMBER BLEY: I lost the thread a

little.

MR. MARRONE: Sure.

MEMBER BLEY: In your calculations here, are these the ones where you removed the Cuba?

MR. MARRONE: No, I'm sorry. We took out from our application hazard, which is actually the red line on the left-hand side.

MEMBER BLEY: Okay.

MR. MARRONE: We took out the hazard contribution from -- or we borrowed it, if you will, for the Cuban/Caribbean sources, and added it back into this sensitivity calculation using the new CEUS model.

MEMBER BLEY: Oh, okay.

MR. MARRONE: So, they both have Cuban and Caribbean at this point.

So, again on the left-hand side you see that the PSHA presented in the FSAR is coming in with higher values of hazard for the high frequency than had we actually used the newer CEUS SSC model.

On the right-hand side, I mentioned there was a slight exceedance in using the new 2012 CEUS SSC model, but it's very slight. It's within a (indiscernible). This concludes my presentation.

Any questions?

MEMBER BROWN: Can I ask one? I'm not a knowledgeable seismic guy, but all that you went through tells us what you ended up with and I'm with the implication that the hazard is less than what the design for the AP1000 design plant is.

Is that a valid conclusion in terms of the source and what it may do to the site? It's not shown in any of the graphs. You didn't show -- I didn't see any AP1000 bounding --

MR. MARRONE: And that's true. In Section 2.5 we deal with site characterization.

MEMBER BROWN: Only?

MR. MARRONE: That's right.

MEMBER BROWN: Okay.

MR. MARRONE: It's the characterization of the site. We'll get to it later where we talk about specific foundation condition --

MEMBER BROWN: That's fine. That's fine. Thank you.

CHAIRMAN RAY: Yeah, it's AP1000 (indiscernible) bounds it, believe me.

MEMBER BROWN: I presumed that based on the discussion.

CHAIRMAN RAY: Any other questions?

Thank you.

MR. MARRONE: Sure.

CHAIRMAN RAY: All right. We're very much on time, but I am concerned because it's the second day, it's Friday. I'd ask that we in accordance with the schedule, return at 10:20 even though we're breaking a few minutes late, because I want to stay on the schedule that we have. So, with that, we'll recess to 10:20.

(Whereupon, the above-entitled matter went off the record at 10:03 a.m. and resumed at 10:20 a.m.)

MEMBER RAY: We'll resume the session with the staff. And Manny has some -- will be responding during the course of this, I believe, to one of the questions we'd asked.

But nominally, we'll be hearing the same material that we've heard from the Applicant. Lisa, are you going to lead it?

MR. COMAR: Good morning again. Is it working?

MEMBER RAY: No. You have to get closer to it.

MR. COMAR: Yes. Now it is on. Good morning. I think there were a follow up question yesterday on the Electrical Bulletin. And we were

not planning to present anything on that.

But at the request, we got it prepared. And we have Bob Fitzpatrick here from the Electrical Branch who will talk about the Bulletin issue that was issued to all sites related to this one.

And Turkey Point has addressed it. And I think Bob has an answer for that.

MEMBER RAY: Yes, I think it's how it's being responded to by Turkey Point was that -- was the question.

MEMBER BLEY: Well, if it would help, I'll repeat what I asked yesterday. And now that you're here Bob.

It's been a while since we met with the staff on the open phase issue. My memory of the last time we talked was the staff had substantial concern that if an open circuit condition existed, and we had a demand, that we could possibly damage some equipment that would take a long time to repair.

Most of the other plants we've talked to since that time still hadn't made the decision of what they're going to do. But Turkey Point has made the decision in it's -- in the report.

So, I'm interested in the staff's

review. They don't have an automatic separation. But I did see, well in very brief notes, what they do have.

And I'm interested in the staff review. But particularly that issue about not having a high side separation if you have the open phase of that.

MR. FITZPATRICK: I'm Bob Fitzpatrick. An Electrical Engineer in the Electrical Engineering Branch in NRR. We're a Center of Expertise. So, we do the NRO reviews.

In terms of the Branch position, we put out a four-part position for the advanced reactors -- the passives, I'm sorry. And Turkey Point now is the fourth in that process that we reviewed.

We reviewed Levy, Lee and Fermi 3 in the process before this one. And provided, you know, the four criteria that we think are necessary.

That's to have a detection system that can actually detect under any circumstances an open phase, one or two phases. An alarm in the control room.

ITAAC to be able to demonstrate that the thing works before it's admitted. And then training for -- training and procedures for the operations and maintenance staff.

So that they know -- that they're really familiar with all the ins and outs of that. So it's part of them as they go forward.

The part we have for like large light water rea -- large active reactors, --

MEMBER BLEY: Not passive, sure.

MR. FITZPATRICK: Right. Is -- the other bullet that would go with them is separate from the graded source. Like automatically. So, it would go quickly.

We've decided that for the passives, where they don't count on offsite power, and it's a defense-in-depth thing, even the onsite AC, defense-in-depth. That we would give them the time to have the operator decide what to do.

MEMBER BLEY: Okay. And I hadn't seen your final position on that since we met last.

MR. FITZPATRICK: Right.

MEMBER BLEY: Let me ask a question about it just so I understand the thinking. Even though the passive plants don't need power right away, they may need power 72 hours away or in some time frame.

MR. FITZPATRICK: Right.

MEMBER BLEY: The equipment we'd care

about, I don't know this for sure, but I'm assuming would get an auto start signal the same as the plants that depend on it. Such that if you had the same condition you were worried about for the active plants, we could have substantial damage to electrical equipment.

It's not likely you'll have that condition, but you might.

MR. FITZPATRICK: Right.

MEMBER BLEY: Is the thinking that 72 hours is plenty of time to recover from the damage you might have? Or is there something else in your thinking?

MR. FITZPATRICK: Well, I -- that's part of it. But I don't think we actually expect damage. Because the safety loads are in the DC part of the system.

And they're isolated through battery chargers from the AC. So, you know, now Reg Guide 1.75 credits battery charges as an active isolation device.

So, it really shouldn't get to the safety loads. Bob?

CHAIRMAN STETKAR: After 72 hours you need things that look like motor driven centrifugal

pumps to put water from Point A to Point B. They are not powered from --

MR. FITZPATRICK: Right.

CHAIRMAN STETKAR: The DC busses or the inverters. That's what Dennis was asking about.

MR. FITZPATRICK: Oh, I see. Well yes, by then they've --

MEMBER BLEY: And they would get out of -- I assume they get out of short signals if you have a demand.

MR. FITZPATRICK: Right.

MEMBER BLEY: Yes. Okay. Well, at least I understand where that was coming from. Now they -- in their Chapter 8, they also talk about having negative sequence protection on medium voltage pumps. Which helps me.

Is that on all medium voltage pumps? Do you know? Did you guys look at that?

MR. FITZPATRICK: I can't answer that question. I'm not sure.

MEMBER BLEY: Okay. And at least my impression from the FSAR was it was only on medium voltage pumps.

Okay. Thank you. That's what I wanted to understand.

MR. FITZPATRICK: Okay.

MEMBER RAY: If there's nothing else, thank you very much.

MR. FITZPATRICK: Thank you.

MEMBER RAY: Okay, you can proceed, Lisa.

MS. SCHLEICHER: Okay. One question for you is -- for whoever out here, for 2.1 and 2.2. To clarify on the SER.

Do you want to hear about that? Or should we go into Section 2.5?

MEMBER BLEY: It's a question from yesterday.

MEMBER RAY: Well I know. I was just trying to think what the question was. What was the question? What did we term that?

MS. SCHLEICHER: So, Rao's here just to make a clarification on the SER that you requested yesterday. If you want to hear about that now.

MEMBER RAY: All right. But there's so much going on, you need to tell me a little bit more about what the question is.

MS. SCHLEICHER: I can let Rao explain.

MEMBER RAY: All right. That's fine.

MR. TAMARA: This is the distance to the

population center.

MEMBER RAY: Oh. Oh, oh, oh, oh. It's that -- it was the --

MR. TAMARA: Is there a connection on it.

MEMBER RAY: All right. In the SER there was a statement made that was -- we finally agreed after a lot of discussion, needed correction.

And the question then for us now, is do we need to make that correction on the record? I think if you can do it briefly, that would be fine, from the microphone is just as well as from the front table.

It was a -- two sentences I believe in the SER that needed to be reworded to be more clear. Having to do with the distance to Homestead versus the distance to the OPZ.

MEMBER BLEY: Oh, I remember that.

MEMBER RAY: You remember that? See, we have a lot going on. It's hard to remember 24 hours later a question that you asked.

So yes, please do. Go ahead. Go ahead and do that on the record, please.

MR. TAMARA: Okay. My name is Rao Tamara. I'm the Technical Reviewer for the Chapters

2.1 and 2.2.

We have in there was a mistake in our SER, stating the distance to this population center as a wrong notation. So, we would like to correct it for the correction as well as for the record, a correct presentation in the record.

The nearest population center, operation greater than 25,000 to Turkey Point 6 and 7 site is the city of Homestead, which is 14.4 kilometers/9 miles west/northwest of the site. Homestead population in 2010 was 60,510. The distance to the population center is one time -- 1.6 times the radius of the LPZ five kilometers.

This is the correction we would like to make and for the record. Thank you.

MEMBER RAY: Thank you. That was the -- it was the earlier version that was the origin of my confusion when I said it was four and a half miles. Because that's what it said originally.

Or that's at least the way it could be read. And then there was the compliance with the requirement having to do with how that relates to the distance to the LPZ.

So, now that's been corrected. And we're now ten minutes late starting. But I'll turn

it over to you.

MS. SCHLEICHER: Okay. Good morning. I'm Lisa Schleicher, Project Manager with the AP1000 Licensing Group for Chapter 2. And so today we'll resume the staff's discussion of Chapter 2 with section 2.5 on Geology, Seismology, and Geotechnical Engineering.

So the staff review team for this Section consisted of geologists, seismologist and geotechnical engineers. So, a team here of geo-scientists.

Today we'll have Alice Stieve, who will be a presenter for 2.5.1 and 2.5.3 on geologic characterization information and surface deformation. And also Meralis Plaza-Toledo who's in the audience, who are the geologists on those Sections.

For Section 2.5.2 on vibratory ground motion, we have a team of seismologists, Dogan Seber who's in the audience, David Heeszel who's here at the presentation, and also myself. I was a technical viewer on the seismology review as well.

And then for the geotechnical Sections on 2.5.4 and 2.5.5, on the stability of subsurface materials and foundations and stabilities of slopes,

we have Zuhan Xi who's here, who will give the presentation. And Luissette Candelario, who's in the audience for the geotech sections.

So, with that, I will turn it over to Alice for 2.5.1 and 2.5.3.

MS. STIEVE: Okay. So could you advance slides until I need to take control of the mouse?

MS. SCHLEICHER: Um-hum.

MS. STIEVE: I appreciate it. Thank you. Okay. My name is Alice Stieve. Can you hear me? Am I speaking --

MEMBER RAY: I was just checking. Your light's on so -- your light's on, so it's much better then I've been doing this morning.

MS. STIEVE: Okay. My name is Alice Stieve. I'm a geologist at NRO. And I was a geologic reviewer for Sections 2.5.1 and 2.5.3.

So, for Section 2.5.1, staff concludes -- next, yes. Okay. Staff concludes that the geologic characteristics of the site region will not affect the design and safe operation of the proposed units.

The geologic characteristics of the site region are also in support of the seismic hazard evaluations that were completed in 2.5.2 and the

surface deformation evaluation for Section 2.5.3.

For Section 2.5.3, staff finds that the potential for surface deformation is negligible within the site vicinity. Because of the limestone issue, my review as very closely integrated with the geotechnical review. Next.

So, the primary topics from our review. Tectonic setting in the age of the tectonic structures within the site region. Including offshore marine environments, particularly as they would pertain to a PSHA determination.

So, as previously covered from FPL, the Turkey Point region is kind of in a novel setting. There is a Florida peninsula and a platform. And then there's the offshore marine environment.

And a very close continental margin. The Island of Cuba and Cuba has its own quite distinct geologic history and tectonic setting.

And then with respect to the limestone dissolution that was the other focus, in the subsurface, in particular the subfoundation portion of the subsurface, there are several different kinds of karst features that are in the site vicinity in region.

And the features come about from

different types of processes. And I will describe those briefly as I go through the slides. Next, please.

So, staff actions for this review include the review of the Section 2.5.1 and 2.5.3. We developed 43 RAIs.

Staff independently reviewed publications provided in the COL FSAR as well as pertinent publications identified by staff. So, what that means is staff pulled many publications that were provided in the FSAR.

And we carefully read those publications and formulated our own conclusions. And then considered the conclusions that FPL derived. And then in addition, staff found many pertinent publications that had not been included in the FSAR.

The third bullet, we met with the COL applicant in many public meetings to discuss a variety of technical issues. We did two site visits, field reviews of drilling operations and looking at some of the surface features.

We reviewed and evaluated a SSHAC Level Two study for tectonic features that were found in the offshore marine environment in the Straits of Florida and the Santaren Channel. We also reviewed

and evaluated SSHAC material for the implementation of the Cuba seismic source.

MEMBER RAY: State the acronym SSHAC just so everybody is clear what it stands for.

MS. STIEVE: Oh. Senior Seismic Hazard Analysis Committee.

(Laughter.)

MS. STIEVE: Okay. Sorry.

MEMBER RAY: Right. Peer review.

MS. STIEVE: Okay. So, here is a map of tectonic features, the distribution of tectonic features. Notably faults and folds that were of particular interest to staff.

It's a simplified version. Turkey Point is the red star in the center of the 200-mile radius circle, starting with Cuba to the south.

Quite distinct geologic history protected deformation, a relic -- that ended in a relic boundary here, plate boundary about 32 million years ago. And then the current plate boundary, the active plate boundary is much farther to the south, on the south side of Cuba.

Cuba is seismically active. Small to moderate historic earthquakes. North of this plate boundary, relic plate boundary zone up here in this

area, this is seismically very quiet. And it's also expected to be tectonically uninteresting and without much feature.

However, because of some unexpected features that showed up in the submarine environment, staff considered that this warranted a special focus with respect to any impact on the PSHA, because it's unexpected.

So, I'll start talking about the fault. So, this is the relic plate boundary here. It's probably associated with the Nortecubana fault system. There's a lot of faults here in Cuba. I have another slide to show you about that.

Going up here to the northeast, this is the Walkers Cay fault, identified in seismic reflection line. It's a normal fault. It's interpreted to intersect the sea floor. So, therefore it's thought to be Quaternary (phonetic) in age.

Coming down here to the southern part of the Santaren Channel, this is where the Santaren anticline and the thrust faults that are in the core of that anticline are. And those were the focus of several papers.

And they did an evaluation of uplift and

uplift rate. And this -- these features were considered to be Quaternary. They do not breach the sea floor. They are just slightly buried beneath the sea floor. Very close to it.

Coming up along the Santaren channel, there is this box here. This is -- these are the strike slip faults that were identified by COLA off the north part of Cay Sal Bank.

There's strike slip, some of them breach the sea floor. So, they are interpreted as Quaternary in age.

Going further up here, this red dot, that's the approximate location of the Miami Terrace anticline that was identified in seismic reflection. It's -- the access of that anticline just barely breaks the sea floor. And it was interpreted in that paper to be perhaps Pleistocene, which brings it into the Quaternary epoch.

This feature here, a black line, it's in the Biscayne Bay. It's a strike slip feature with a little bit of normal offset. It is beneath Biscayne Bay, but it is also buried beneath about 400 feet or more of sediment. So, it is a buried fault.

But, because it was somewhat young, it could be as young as .53 million years old. We're

concerned about it. Okay. Next.

So, here is a close review of faults in Cuba. FPL implemented an aerial source term for the SSC. And staff had found several papers that concluded that some of these faults were Quaternary or even seismically active.

And so, we were concerned that FPL did not sufficiently consider this for the SSC model. So, it was a result that resulted in a lot of discussion in public meetings with FPL, as well as several RAIs.

And they implemented a SSHAC study to evaluate this. And they provided more analysis of these faults the FSAR. And they also did a sensitivity study, and we did one too.

So, the research on the island of Cuba, it's a, you know, a poor and repressed country. And it doesn't have the same standards or the same financial backing to do the level of studies that we might expect here in the United States.

So, they didn't -- we don't have like seismic trench data or radio carbon dates or things like that. So, to determine the age of these faults definitively in order to put them into a site characterization -- or a hazard evaluation is

challenging. So, next slide.

Here's a table of the tectonic features that were in the previous map. These are the ones that staff focused on because they were in an area where we wouldn't expect tectonic features. And they were thought to be kind of young.

So, for Biscayne Bay -- oh, I want to make a note about the age. So the age of these things, these are estimates. Typically for offshore marine environments, there is seismic reflection data and there's a limited amount of drill core data.

And they do a correlation and do seismic stratigraphy to evaluate what the levels of the stratigraphic intervals that are faulted or deformed. So, they're estimates. And in some cases, they're bracketed by the age of the youngest deformed sediments and then the age of the nearest undeformed sediment.

For Biscayne Bay, that's the one on the top, this is the strike slip fault in Biscayne Bay. It's unnamed. It could be as young as early Pleistocene, which is 5.3 million years old. And that is clearly outside of the Quaternary-epoch.

So, it is old enough so that we don't

really worry so much about it with respect to PSHA. So, there was no sensitivity test that was needed or done for that.

So for the Biscayne Bay, for the next one down, for the Miami Terrace anticline, that's a Miocene to apply a Pleistocene. At Pleistocene, that earliest stage is within the Quaternary.

And staff did not agree with the Applicant's final position about that feature. So, we went ahead and implemented our own sensitivity analysis to address impacted PSHA.

The same things is also true of the Cay Sal features. We implemented our own sensitivity study on that to resolve that issue.

For the Santaren anticline and the Walkers Cay fault, the Applicant agreed to do a sensitivity study. And for the faults in Cuba, the Applicant did one that compared aerial source to seismic -- to fault sources. But we also implemented one of our own.

The Walkers Cay through the Biscayne Bay, those features all have very low deformation rights. And David is going to talk about the sensitivity study that was done for that. He will give you more details about that.

MEMBER RAY: Will he give us more details about the Biscayne Bay? Given that you said you didn't do a sensitivity analysis based on its age.

MS. STIEVE: Well, I'd have to give you those details. I'd have to give you those.

MEMBER RAY: Okay.

MS. STIEVE: So, I have an extra slide. I didn't put a picture of the Biscayne Bay strike slip fault here. We have a -- I have a seismic image.

MEMBER RAY: Well, here's the thing. I spent a lot of my life defending a non-capable fault quite close to a nuclear plant. So, I'm interested in how you concluded that it's not relevant here.

Just how do you go about doing that? And --

MS. STIEVE: So, the seismic reflection images that were done on Biscayne Bay are about to, I think there are 13 seismic lines that cross it. And it extends for about 13 miles through Biscayne Bay.

In none of those seismic reflection profiles does it go above the Arcadia unconformity. And the Arcadia formation is between 23 and 5.3

million years old.

And so that Arcadia unconformity is maybe about 5.3 million years old.

MEMBER RAY: Okay. I'm familiar with that methodology then.

MS. STIEVE: Okay.

MEMBER RAY: You have a non-offset above --

MS. STIEVE: Yes.

MEMBER RAY: Okay. And do you know the extent of it in terms of its length? Or has it just been identified in a given area but there's no known, or defined limit to its length?

MS. STIEVE: The limit is defined by the seismic reflection line. That's the only way we know it.

MEMBER RAY: No, no.

MS. STIEVE: And it wasn't chased to its either terminus.

MEMBER RAY: Okay. So, we don't know the limit, but we do know that it's overlain by a sufficiently old --

MS. STIEVE: Yes. Undeformed sediments.

MEMBER RAY: Yes. Okay.

MS. STIEVE: So, it goes to the top of

the Arcadia unconformity. So, the Peace River formation and the Tamiami formation and the Fort Thompson, all the way up to the surface are flat lined and undefined.

MEMBER RAY: All right. That does it. Thank you.

MS. STIEVE: All right. So, because of the sensitivity analysis, I was able to make the conclusion that we don't have any tectonic features in the 200 miles that are going to impact the PSHA.

And so now we go onto the next. And I'm going to talk now about the potential for surface deformation.

So, the Florida Peninsula is part of a large, long standing carbonate bank system. There are various limestone/dolostone/anhydrite formations that underlie the Turkey Point, so of course karst would be something we would want to focus on.

And my review focused on the undetected subsurface voids. Because the surface features are obviously irrelevant to the safety hazard.

But, they might be an indication of what's going on in the subsurface. And my review was closely interfaced with geotechnical for obvious reasons.

So, the several different kind of karst features that have developed through different kinds of dissolution processes or environments are found in the site vicinity and just beyond.

Turkey Point does not have the classical cover collapse sinkholes that are associated with the sinkholes in central and northern Florida that will, you know, take in cars and houses and things like that.

There's no -- there's effectively no beto-zone at Turkey Point. You're right there with a few feet of muck, unconsolidated loose sediments that are right there at the hard rock. And that's where the dissolutions occur at the limestone.

MEMBER RAY: We did do Levy, which is of course where you're talking about. That's not the case.

MS. STIEVE: Right.

MEMBER RAY: Yes.

MS. STIEVE: There's a deeper -- there's a beto-zone there. Right.

So, the site does have surficial features. And it also has zones of secondary porosity. In the vicinity and beyond there are submarine sinkholes that are off on the Miami and

the Portales Terrace.

There are subsurface seismic sags. And I'll talk a little bit about those. There are paleo-sinkholes. There are submarine springs and dry caves. Next slide.

So, here's a distribution map of various features. I'm not going to go into each individual. It's just to show you mostly the distribution, the scatter of these features in the site vicinity and a little beyond.

So, what isn't shown on here are the tiny surficial depressions that are scattered all around the Turkey Point site and in other places in southern Florida. I'll show you a slide of that. They're too tiny to show on this.

And it also the subsurface second zones of secondary porosity are not indicated on here. But, what I want to point out to you are the red dots here in Biscayne Bay.

These are the seismic sags that Cunningham identified in seismic reflection data. They're also up here too. But, I'm only going to talk about those. And next please.

So, these are the surface dissolutions features at the site. The yellow dots are from

older aerial photography superimposed on modern aerial photography.

FPL refers to them in their documents as shallow vegetated depressions. They're about six feet deep. And they are typically filled with peat. They are not like covered collapse sinkholes. They are entirely a surficial feature.

There's not beto-zone. The water feature -- these features form under rainfall and spring flood conditions, fresh water flooding conditions. They have a gently undulating surface on hard rock -- on the hard bedrock surface of limestone. And it just dissolves.

Algae and microorganisms grow. And the acidity is somewhat aggressive against these shallow depressions.

And so based on my concern about what the origins were, and the possibility of voids beneath, Paul Riz and Associates implemented a supplemental field study that he talked about previously, where they did incline borings to go -- to reach beneath the site -- the paths.

And also did McCauley Samplers through the peat to determine the hollow scene section that's the youngest part of geology -- the geologic

history for the site.

So, these are entirely surface dissolution features. We don't worry about voids forming beneath them. This is an example of secondary -- of core from the secondary porosity zone.

This is the one that's out of the Key Largo. And it's the touching log of porosity. And you can see it's centimeter scale or finger scale.

And this is something that occurs in the shallow subsurface in a salt water and fresh water mixing zone within the water table aquifer. This is not a surface dissolution thing nor is it a cover collapse.

So, the water table aquifer is like a sponge that holds water. And when rain falls on the Peninsula and sinks down into that aquifer, it's not going to mix like an open bucket of water. It fills voids and conduits.

And from the sea, the sea intrudes into this aquifer. And the seawater is denser then fresh water. So, there's a salt water/fresh water lens. And this is a simplified version of what's going on in the Biscayne Aquifer.

Seawater is saturated, especially as it

sits in the water table aquifer, which is limestone. It is saturated with respect to calcium carbonate.

Likewise, the fresh water that sits in that Biscayne Aquifer is saturated with respect. So, it's not going to dissolve calcium carbonate.

But when they interface at the lens surface, there's brackish water. And there is a lack of saturation. Because the mass that is dissolved in either the fresh or the salt water is not the same.

So, it -- that zone of brackishness is the mixing zone. And it can be aggressive against limestone. And it can dissolve things in shallow aquifers.

This -- the zone moves with respect to climate change and with sea level fall and rise. And right now this interface is way to the west, a few miles, several miles to the west of Turkey Point site.

It's not going to come back. Because sea level is going to continue to rise and press this to the west because of climate change. Okay, next.

This is an image of a seismic sag in Biscayne Bay. And this likely developed --

MEMBER BLEY: I'm sorry. On your last slide, you concluded it's moving west. And the consequence of that, is that what we've heard this morning?

MS. STIEVE: Yes.

MEMBER BLEY: We'll be getting precipitation in here instead of further dissolution?

MS. STIEVE: Yes. Right, and you can see that --

MEMBER BLEY: You'll agree with that?

MS. STIEVE: Yes. He covered it. Paul covered it.

MEMBER BLEY: You can see that, yes.

MS. STIEVE: Yes. You can see that in there. And they're terminated calcite crystals here. And that would indicate that those crystals formed after the voges opened up. They had to open up first in order to get terminated calcite crystal. Okay. So, okay.

So these are -- this is a picture, a seismic collection picture of the seismic sags or the structural sags that were identified by Cunningham and co-authors in several papers from 2009 to 2015.

I don't know how familiar you are with seismic reflection or how much you want me to go into this. But, it's seismic reflection is like a sonogram.

And it's revealing subsurface hidden bedding plain surfaces and -- by reflecting sound waves. So, the black and the red lines -- well, I don't know if you can see it so much on here.

But, the black and the red lines are the reflections. The colored bands are the author's interpretations. So, the blue zones are where there are permeable zones or aquifer zones.

And there are also formation tops that are identified. Like right here is the top of the Arcadia formation. There's the top of the Peace River and the Tamiami, and then up to the surface.

So, these are, the ones up here, you know, notice are flat line -- are flat line more or less continuous. And the reflections of course get nicer as you go deeper in the section.

Here at the top of the Arcadia formation there are -- we have inclined bedding that is in this limited zone here above this feature I'm going to talk about.

So, as we go down further, you can see

that the seismic reflections are broken and they're truncated. Or they're folded. And it indicates a zone of collapse or bracha or disturbance.

The authors interpreted this feature, this tall vertical feature here as a collapsed paleo-cave system. And the end of the deformation is indicated by these lines here.

And we just have a little bit of incline strata. And this is the limit of the deformation.

Underneath Turkey Point, this interface here, this surface is at least 400 feet below grade. So, there's 400 feet of undeformed sediment above it.

This forms -- this is an example --

MEMBER SKILLMAN: Is it 400 feet of what please?

MS. STIEVE: Of undeformed sediments riding above where this last bit of deformation is.

MEMBER SKILLMAN: Undeformed sediments?

MS. STIEVE: Undeformed flat lined sediments.

MEMBER SKILLMAN: Okay. Thank you.

MS. STIEVE: So, a bridge.

MEMBER SKILLMAN: Okay.

MS. STIEVE: So this is an example of

hypogenic dissolution. This is a little different then stuff that happens at the surface in the water table aquifer or in the mixing zone.

This is something that occurs in a confined aquifer, the Floridan Confined Aquifer. And it is an indication of vertically moving water going upwards.

And it -- and the water can be aggressive to limestone from a number of different reasons. It could be for differences in saline or differences in temperature.

But, in the case here perhaps it is because of hydrogen sulfite that comes from the carbonate materials themselves. And so it dissolves on its way going up and then it collapses.

But the important thing here is that the deformation is limited to the top of Arcadia formation. And that we have all these other flat lined sediments above it.

MEMBER MARCH-LEUBA: Hold it. Keep that picture. Horizontally, what much of an -- how much of an area is represented? I mean, is this a picture of one mile?

MS. STIEVE: Okay. It's about four and a half miles. I have the -- I have it down there at

the bottom.

MEMBER MARCH-LEUBA: Oh, there it is. Four and a half miles.

MS. STIEVE: See, four and a half miles. But in terms of the size of these things, they range. So, out of his publications, an average of about 355 meters diameter.

Some of the larger ones -- this is a larger one. He thinks it might be a coalesced series. They might be as much as 24 hundred meters long.

They're very deep. The actual structure is a very deep structure, like in this case here. They can be 700 to 30 meters to all the way to the lower part of the Floridan Aquifer, which is three thousand feet.

So, they're very tall.

MEMBER MARCH-LEUBA: Okay. On this bottom blue line down there, will that be the boulder zone we're talking about yesterday? Is that three thousand feet?

MS. STIEVE: Yes. I'm -- it's not a -- I don't have his legend. But I'm pretty sure that that dead zone is the boulder zone.

But I would have to go back to his

seismic lines to see his legend.

MEMBER MARCH-LEUBA: It's on the right elevation?

MS. STIEVE: Yes. Right. Okay. Next. So, this is a simplified stratigraphic column. Maybe the seismic reflection is not as discernable to you.

But, this is how it would shape up in a simplified column. Here's the Arcadian unconformity. Here's kind of like the seismic sags as they are interpreted.

Mostly, characteristically, typically in Biscayne Bay they are below the Arcadia unconformity. Some of the ones that are up in the north side of Miami come up into the Peace River formation.

There's the zones of secondary porosity. And here's where the foundation's going to be up here. So, there's all this that's undeformed above it. So the next slide, please?

MEMBER BLEY: I'm -- or Alice, I'm just puzzling in my mind why they're called seismic sags?

MS. STIEVE: He just named them that. Because it's out of seismic reflection. I don't know why he called them seismic sags.

MEMBER BLEY: Okay. All right. It's got nothing to do with --

MS. STIEVE: He could have called them structural --

MEMBER BLEY: Seismicity. It has to do with the fact that it was a seismic --

MS. STIEVE: Exactly. But that's what it says in his paper.

MEMBER BLEY: Okay.

MS. STIEVE: That's what he called them. Later on he changed his mind and he called them structural seismic.

MEMBER BLEY: All right. Good enough.

MS. STIEVE: Anyway. So, the further resolution of limestone dissolution issues are heavily dependent on the grouting plan and in the ITAAC that's associated with that.

That provides us with an extra margin of safety. And Zuhan is going to give us details about that.

And then my -- so for my surface deformation finding, thank you, I am concluding that surface deformation at the site is negligible based on the data that's from the Biscayne Bay subsurface sags is characteristically at or below the Arcadian

unconformity.

The deeper bore holes at Turkey Point do not reveal any large voids. And the grouting plan for the power black -- for the power block subfoundation and associated ITAAC are going to provide the extra margin of safety. Next.

And then I'll conclude with the geologic mapping license condition that is part of the SER. This enables NRC to verify that site specific features that are going to be revealed in any excavations will be properly documented.

And that the institute conditions found in the excavations will corroborate the previous site characterization conclusions that were used in design analysis. That's the end.

MEMBER RAY: All right. Thank you, Alice. And probably you should now turn off your microphone since it's a source of a lot of distraction eventually.

Okay. Next?

MR. HEESZEL: Good morning. I'm David Heeszel, a geophysicist at NRO. I'll be presenting the vibratory ground motion portion of the presentation.

So, there were a couple of questions

that were posed to the Applicant. One was regarding recommendation 2.1 seismic.

We did look at the updated GMRS for the existing plants. It's below the GMRS for the new plant. There's different guidance for the development of that -- for the reevaluation.

They've followed a guidance document developed called the SPID, the Seismic Prioritization Screening -- and I can't remember the entire acronym. But, the results are lower than this current evaluation.

And then earthquake records at Florida -- sites in Florida. The strong motion recorders at the existing plants are triggered recorders.

So, unless the ground motion is high enough to cause a concern at that plant, they won't record an earthquake. So, in terms of using data for developing ground motion models, it's not there. Next slide.

So, the review of 2.5.2, our focus was on determining that the FSAR provided adequate information to support the GMRS conclusions. Our review -- as a part of our review, we developed 13 RAIs.

We reviewed external publications that

were relevant to our understanding of seismicity and ground motion issues at the site. We participated in two site audits at the site as well as a third site audit locally, or a third audit locally reviewing the SSHAC level two study focused on tectonic features in the offshore marine environment, which Alice outlined.

And then we conducted sensitivity studies and confirmatory analysis as appropriate to test Applicant's inputs and assumptions. Next slide.

Primary topics or focuses, foci of our review. The Applicant's hazard characterization using the older EPRI-SOG model compared to the most recent NRC endorsed CEUS-SSC model which is published in NUREG 2115.

Potential hazard from sources outside of the EPRI-SOG model including Cuba and the greater Caribbean, and then the local sources including the Miami Terrace anticline and the Cay Sal Bank features. The Applicant's use and development of the Caribbean ground motion model and finally, site response and informatory calculations. Next slide.

So the Applicant used the EPRI-SOG seismicity model, seismic source characterization

model to account -- and updated that model to account for the time since its publication in the 1980s.

And the Applicant updated or added/extended source zones as appropriate to account for the limited extent of the EPRI-SOG model. So, you can see here, this brown outline is the limit of EPRI-SOG.

And then they've supplemented that with this shaded zone right here. And then they also used the Charleston seismic source from the Vogtle FSAR. Next slide.

This slide is a map of the Applicants seismicity as well as our confirmatory seismicity map and the updated seismicity. So, the seismicity that's occurred since the Applicant submitted its application.

And very briefly, the Applicant's catalog are the dark gray circles. The hollow blue circles are our confirmatory catalog. And then the yellow dots represent seismicity that's occurred since -- well, through January 2015, but since 2007?

MS. STIEVE: Yes.

MR. HEESZEL: So you can see that there's not -- there's not much seismicity in the

recent past. Next slide.

So, we compared our results with the -- or we calculated seismic hazard from the CEUS-SSC using the model in NUREG 2015 and compared it with the Applicant's model using EPRI-SOG. And you see here one hertz, ten hertz, and PGA.

I will note that rather than using -- we didn't use the Caribbean contribution. We only considered the central and eastern United States since the Caribbean is going to be the Caribbean.

And then you can see that with the exception of one hertz, the Applicant's hazard envelopes the staff's confirmatory results. Next slide.

So the Applicant evaluated Cuba in its PSHA as a single aerial source. They performed the sensitivity analysis you heard about earlier, in response to our questions.

And they considered the single aerial source -- a single aerial source with an increase in seismicity and then individual fault sources that they scaled according to moment -- seismic moment concerns.

But they did not consider a single source zone with the explicit faults as they were

originally proposed. Next slide.

So, we felt that based on some of the comments in the SSHAC report that that was a reasonable interpretation to make. So we went back and using some of their sensitivity results, calculated how the hazard would change as a result of considering the full fault model.

And you can see here, the green line is considering the full fault model. And then the violet dotted line is the FSAR hazard.

So, the single source area and the full fault model. So, it's essentially a double counting of earthquakes.

And the results are that the seismic hazard doesn't change very much. The increase in hazards is minimal.

MEMBER RAY: And just so I'm clear, the SSHAC process included the Cuban source or not?

MR. HEESZEL: Yes. Yes. So, they solicited comments back from the reviewers. And some of the reviewers felt that full fault was not inappropriate.

MEMBER RAY: Yes. I'm more thinking that should have surfaced any prospect for some much larger then -- earthquake then has been experienced

to date. With the SSHAC process, one would expect would say well, there's a capability here because of the length of the fault that is much greater than anything we've seen before.

And that's why when you were talking about these small events that have happened in the recent time, you know, in a SSHAC assessment typically that will be irrelevant to the conclusion that this is a very long fault that has the capability of a large earthquake if it gets locked up.

MR. HEESZEL: Well that was -- I mean, that was considered in the full fault model. I mean, that would have been one of the pieces that would have fallen out of it.

MEMBER RAY: I mean, it's far enough away I have no idea what a large magnitude earthquake on that fault is. But it's obvious they're very active. And that's why I was wondering.

As long as it was part of the SSHAC review, that's fine.

MR. HEESZEL: Yes. No, I mean the faults -- or the potentially active faults in Cuba would have been considered through that process.

MEMBER RAY: Okay. They weren't just looking at --

MR. HEESZEL: No.

MEMBER RAY: They didn't exclude the Cuban fault?

MR. HEESZEL: No. So, the Applicant developed a new ground motion model for the Cuban and Caribbean seismic sources. And in the process of that development, the staff requested additional information on the applicability of the new ground motion model for the region between Cuba and Florida.

And the Applicant provided us with the new empirical data that you saw the lines. They observed -- they took observations of ground motion within the Florida peninsula and compared them to their ground motion models.

In addition, the staff conducted a sensitivity calculation and determined that the new ground motion model was adequate for calculating seismic hazards at the Turkey Point site. Next slide.

So for the local seismic sources such as the Cay Sal Bank features and the Miami Terrace anticline, the staff performed a PSHA sensitivity

analysis to assess the hazard impacts of these potential local tectonic sources that are not explicitly included in the EPRI-SOG model.

So, as a part of this the staff used the most recent NRC endorsed ground motion model, the EPRI-2013 model. The source geometries we obtained from available geologic and geophysical information.

And we considered a variety of slip rates because there is little to no data on these -- on what the slip rates for these potential features might be. And our overall conclusion is that these local sources produce negligible input to the total seismic hazards. Next slide.

So this feature -- this slide shows the results of our sensitivity analysis at one hertz for the Cay Sal Bank and the Miami Terrace. And you can -- each of these colored lines represents a single slip rate.

So we calculated for a variety of slip rates. Based on information from the Santaren anticline, the slip rates are between the dark blue and cyan color. Between .01 and .05 millimeters per year.

And you can see here that those basically overlie the black curve for the Cay Sal.

And then also for Miami Terrace, the change in hazard is very, very tiny.

Finally, we performed a site response confirmatory analysis. We used the hazard results developed by the Applicant, site soil and rock properties as described in the FSAR, and we used our own software.

And this is for ten to the minus four, the low frequency controlling earthquake. And you can see that our results are very similar to the results from the Applicant.

And that concludes the 2.5.2.

MEMBER RAY: Okay. Any questions for David?

MEMBER REMPE: I'm curious about some of the discussion earlier. Is this the only site in the U.S. where you consider offshore seismic activity in your evaluation?

MR. HEESZEL: No. It would have been considered as part of, for example, PSEG. The ESP at PSEG.

MEMBER REMPE: Okay.

MR. HEESZEL: And I would ass -- well, it's probably marginally for STP.

MEMBER REMPE: Okay.

MR. HEESZEL: So any site that has offshore environments within the radius, the 200-mile radius, that would be a consideration.

MEMBER REMPE: Okay. But it was not considered in the reevaluation of seismic hazards?

MR. HEESZEL: No. Those are more a limit -- a more limited evaluation. The other thing too is that the CEUS-SSC model extends further offshore then the EPRI-SOG model.

MEMBER REMPE: Okay. Thank you.

MEMBER RAY: Okay. If there's nothing else we'll go onto the next presenter.

MR. XI: Hi. Good morning. I'm Zuhan Xi, Geotechnical Engineer in the Office of New Reactor. I'm here to present you the staff's safety review of FSAR Section 2.5.4, stability of subsurface materials in the foundations, and Section 2.5.5, stability of slopes. Next slide, please.

For FSAR Section 2.5.4, the staff evaluated the whole area as listed on the site. I don't want to repeat that.

During that review of the FSAR Section 2.5.4 the staff conducted two site audits and had many conference calls and meetings with the Applicant. And issued a total of 37 RAIs.

The current status of the staff's safety evaluation is there's no open item. Two site specific ITAACs, one is for the concrete field, and one is for the grouting program. I will discuss this in the -- further at future sites.

One confirmatory item for II2.5.4-26, which tracks the updates of the FSAR in the future revision to include the information related to the grouting program. Next slide, please.

Yes, this is a similar picture you saw from FPL presentation this morning. This figure is a conceptual cross section I developed to provide a visual image for excavation, grouting and backfilling.

Subsurface shows much muck and peat will be removed around the plant area and replaced with compacted lime rocks. The finished grade will be raised about 25 feet to maintain the floor entrances and openings for all safety related structures above the design base's flood elevation.

Prior to excavation of limestone, I reinforced the concrete diaphragm wall where we installed a surrounding each power block to act as a cut for horizontal groundwater flow into the excavation.

Then grouting will be performed in a series of SPAC space the borings to form a 20-foot sink grout division. And an additional 50 sink extended grout division to achieve the watering function and to constrain void sizes.

After grouting, Miami limestone and a portion of Key Largo limestone were within the boundary of diaphragm wall will be excavated. A 19 foot thick concrete will be casted to support the foundation of the nuclear island. Next slide, please.

As mentioned in the previous slide, there are two site specific ITAACs related to subsurface material as the result of the safety review. One ITAAC is for the concrete field and the seismic category one structure.

The purpose of this ITAAC is to ensure that the concrete field meets the requirements on the compressive strands thermo-crack contours for mass concrete. And that the ability under the groundwater chemical condition.

The other site specific ITAAC is for seismic category one structure foundation grouting. The purpose of this ITAAC is to ensure after grouting the sizes of any remaining void will be

restrained to certain limits.

By the way, grouting of a foundation to reduce the permeability of the rock is widely practiced in the industry. I will discuss the staff's evaluation on the grouting ITAAC and associated grouting plan and grouting test program as well as the sensitivity analysis. Next slide, please.

This slide I will discuss a potential subsurface voids created by limestone dissolution. The evidence is by the Applicant's site investigations include two -- indicated the two dissolution features at the site.

One is the vegetative depression within the Miami limestone. The other is secondary porosity in limestone, particularly in the Miami and Key Largo limestones.

Also, results from the site geotechnical subsurface investigation showed that at the area of our site vegetative depression and at the green gauge. A total of .32 drop observed.

Individual drops in the vertical borings ranged from .44 to four feet at the area inside of vegetative depression and at the green gauge. A total of 4.3 percent to drop observed.

Individual drop in the inclined borings ranged from .3 foot to 2.5 feet. Next slide, please.

During the site audit, the staff examined the core samples. You already seen this morning the sample brought by FPL, you know, demonstrated previously for the outlet image.

This is a secondary porosity in the Key Largo formation. And also the boring right image showed a more secondary porosity in the Fort Thompson formation. So, you will see these, you know, in the centimeter scale and these two voids are kind of different.

That the more dig void in the Fort Thompson is more isolated compared with the dissolution -- varied dissolution in the Key Largo formation. Next slide, please.

The staff reviewed Applicant's site investigation and the result, then summarized as follows. Geotechnical investigation followed NUREG Guide 1.132 to characterize the site.

Initial and supplemental site investigation established the foundation design parameters. Frequency of two drop is less than .5 percent site wide based on the performed site

investigation.

Maximum slant of the two drop in the borings is limited to four feet site wide and 1.5 feet within the building footprints. Available data from site investigations suggests no significant large void beneath the site.

However, grouting program is warranted for minimizing the impacts of potential undetected voids. Next slide, please.

Initially the Applicant planned to use micro gravity survey on the excavation surveys to detect voids or verify the absence of voids. The staff questioned the Applicant about RAIs about its micro gravity data methods and its determination of the critical void site.

After staff's RAI, the Applicant decided that it may not be feasible to determine the critical site beneath the micro gravity -- that could cause micro gravity surveys can only calculate large voids evidence instead of micro gravity surveys.

The Applicant then decided that the subsurface grouting program, which was only planned for the watering purpose initially, would be utilized and enhanced such that potential voids will

be physically sealed, reduced or constrained.

The grouting ITAAC was developed to ensure that any remaining void in the 25 foot thick grouted zone are structurally insignificant. Any remaining voids in the 50 foot thick extended grouted zone having a maximum diameter or equal to or less than 20 feet.

The grouting stage closure criteria will be developed based on the result of grout test program. Grout and mixes will be tested to assess mobility, stability and durability.

Mix design to ensure laboratory testing grout replacement and field testing will be performed in a quality program. Next slide, please.

During the staff's review of the grouting approach to constrain the void sites, the Applicant was requested to demonstrate how the maximally assumed 20 foot diameter void sites, if exist, is not a concern to the stability of subsurface material and foundations.

The Applicant performed a sensitivity analysis to address the staff's concern. The staff reviewed the analysis by evaluating its final element model and the modeling approach, including

model sites, and mesh sites, boundary conditions, loading and loading sequences.

The staff noted that the sensitivity analysis considered a very extreme case for cylindrical voids with a 20 foot diameter circular cross section. The void extended east to west of the whole nuclear island.

The top of the void is right below the grouted zone, which is around the irrigation minus 60. The staff evaluated the facts of the void on sediment barring capacity and the potential change in the concrete field.

Analysis shows that conservatively assumed the void does not present stability concerns to the subsurface material at the site. Next slide, please.

This is staff's assessment for the -- of potential subsurface dissolution voids. Staff confirmed the result of the Applicant's site characterization by examining of the bore hole analysis and geophysical routes in the rock core samples during the site visit audits in the FSAR review.

Staff concluded that Applicant's postulated 20 foot void in the extended grouting

zone is conservative based on the data around the geotechnical investigation. And that the configuration of the primary grouting holes, in particular this morning you saw the figure from the Applicant that shows the bore hole spacing -- the primary bore hole spacing is 20 feet apart.

Okay. The staff determined that result of the Applicant's sensitivity analysis for the cylindrical void was 20 feet diameter across the nuclear island is conservative by comparing acceptance criteria in AP1000 of the DCD.

Staff concluded that with implementation of the ITAAC, including grout closure criteria in the specific bore hole spacing, the limestone under the concrete field will be grouted to contain voids so that stability of subsurface material will not be a concern. Next slide, please.

After review of the FSAR 2.5.4, staff concluded that the Applicant complied with the applicable regulations. Conducted its investigation at the appropriate level of detail.

Included adequate margins of safety in the design analysis for the construction and operation of the nuclear -- for the nuclear power plant.

Updates of the FSAR in the future revision to include information related to II2.5.4-26, which is the grouting program to constrain potential voids is trapped as a confirmatory item. Next slide, please.

Okay, this slide is for the Section 2.5.5, stability of the slope. FSAR Section 2.5.5 addressed the stability of all earth and rock slopes.

Staff evaluated the FSAR 2.5.5 including slope characteristics. And evaluation of design criteria and the design analysis. Next slide, please.

After review of FSAR 2.5.5, staff concluded no potential slope failure that -- at the site would adversely affect the safety of the nuclear power plant structures.

Because design does not use the safety related dams and embankments. And that there are no existing upstream and downstream dams that could affect safety related facility.

Permanent slope are directly away from the power block and have a maximum grade of .5 percent rate. MSU retaining wall is no closer than 500 feet away from the seismic category one

structures. And therefore potential failure of the MSU would not affect safety related structures.

The temporary slope that will be excavated from plant constructions do not adversely affect the safety of the nuclear power plant facility. Applicant can apply the ways properly with the regulations.

That concludes my presentation.

MEMBER RAY: Thank you. Any questions? Yes?

MEMBER BROWN: Just one.

MEMBER RAY: Go ahead.

MEMBER BROWN: After, and I meant to ask this of the FPL, I just forgot. So, you get to answer it.

After the grouting is done, is there a sample of the grouting area, or the volume to see that adequate fill or that it had been -- relative to the previous cores that they had when they did their sampling and stuff?

Or is it just a process where by going and seeing where you have instrument, or you know, drops or what have you, that you may have to go to smaller diameter -- or you know, smaller spacings for additional?

So, is it a process issue? Or do you actually test the grout afterwards to see that it's filled?

MR. XI: Yes. For the grouting program, you know, basically they have a -- they worked it -- well, they will through the grouting test program to make -- to develop all these parameters, closure criteria to make sure these grouting will effectively grout at these holes.

They will develop these closure criteria. And also, they will take some samples to make sure after grouting, these voids will, you know, close.

MEMBER BROWN: Okay. So, they sample the completed -- once they finish grouting, they do some samples to see --

MR. XI: Right. To confirm, yes.

MEMBER BROWN: And instead of doing the whole thing.

MR. XI: Yes. Yes.

MEMBER BROWN: Just as a confirmatory.

MR. XI: Yes.

MEMBER BROWN: Okay. Thank you.

MEMBER RAY: Anything else? Lisa, does that do it for now?

MS. SCHLEICHER: Yes. That concludes the staff's presentation for 2.5.

MEMBER RAY: All right. Steve, are you guys capable, or I mean, ready, prepared to talk about the issue of dilution? If not we'll do something else here.

MR. FRANZONE: Yes, but one moment, please.

MEMBER RAY: Sure. I'm just trying to get our list of -- we'll be going to the staff now so that -- I mean, we'll be going to the Applicant now either immediately or after lunch.

So, thank you staff for your presentation. I'm just trying to get off my list here things to do.

So, the question that Charlie had was, what if we're making a release, an unplanned release without dilution? Do we have a way to detect that and stop it before it continues indefinitely?

MR. ORTHEN: Yes. Richard Orthen, FPL. There are two ways. In DCD 2R2, Section 11.2.42, They specify radiation monitored signal.

Basically, set points are calculated prior to discharge. And radiation monitor set point is calculated such that after dilution you are below

the part 20 limits.

MEMBER RAY: These are on the discharge piping?

MR. ORTHEN: Yes. Downstream of it.

MEMBER RAY: Of the mix?

MR. ORTHEN: Correct.

MEMBER RAY: So you're monitoring the --

MEMBER BROWN: I was just -- I'm sorry, go ahead.

MEMBER RAY: No, I was just saying, you're monitoring the diluted discharge?

MR. ORTHEN: Right.

MEMBER BROWN: But my point was that after it comes out of the -- so, thank you very much. After it comes out of the pump sump, whatever it is, and the line going over to the -- the discharge lines to go down to the deep wells?

MR. ORTHEN: Right. This monitoring is occurring basically within the plant. Okay, so it's way upstream of, you know, like the wells that we showed on the screen.

MEMBER BROWN: No, I understand that. But I mean, it's just -- it's not -- it's after it comes out of the dilution mixing whatever it is in the sump where you -- you've got the sumps, but the

whatever it is, the -- I don't have a picture right now. But --

MEMBER RAY: Charlie, the liquid rad waste is injected into the discharge after the discharge is -- that comes out of the sump.

MEMBER BROWN: Exactly the thing --

MEMBER RAY: So it's after that point that this monitor is --

MR. ORTHEN: To clarify, just to make sure there's no understanding. This radiation monitoring occurs prior to it being diluted. Because after it's diluted, it's, you know, --

MEMBER RAY: I heard you, it's dilution.

MR. ORTHEN: Right. Well, it's -- when the set point is calculated, it's calculated based on a dilution flow that you need to achieve.

So, it's very difficult to do radiation monitoring after, you know, these vast quantities --

MEMBER RAY: Yes. But we misunderstood what you said earlier. We thought you said you were monitoring the diluted discharge.

MR. ORTHEN: No.

MEMBER RAY: You're monitoring?

MR. ORTHEN: The contents of the tank, of the monitored tank contents being discharge --

being sent to the dilution line.

MEMBER RAY: Well, but supposing it's -- there's no flow in the -- of dilution flow?

MR. ORTHEN: I'll get to that. There's also a flow ratio that is part of the plant interface.

It looks at the flow that's required coming out of the discharge tank, the monitor tank. Ratioing it to the required flow -- dilution flow.

And these are all pre-established in the calculation prior to the discharge. So, if that flow ratio is not satisfied, i.e., you lose solution flow, there's automatic termination of the release.

MEMBER RAY: So you're monitoring two things. The dilution flow and the radiation --

MR. ORTHEN: Correct.

MEMBER RAY: Level of the rad waste being injected into the dilution.

MR. ORTHEN: And that's pretty standard across the industry.

MEMBER RAY: Yes. And I misunderstood what you said earlier. I thought you said we're monitoring the diluted flow.

MR. ORTHEN: No. I'm sorry for the misunderstanding.

MEMBER BLEY: And how would you catch an erroneous calculation such that you diluting the way you thought you said to, but you calculated wrong? Or you're dumping ten times more in then you thought, then you would have wanted to?

MR. ORTHEN: Well again, there are -- and design hasn't been totally, you know, it's level detailed design.

But there would be like existing plants, there will be, you know, warning levels, alarms. When you're approaching a set point level, for example, for flow or for radiation, you know, warning levels.

And then at the high levels where you're going to terminate the release, it's based on either flow or radiation signal.

MEMBER BROWN: So let me -- okay, I'm trying to get a handle on what you said there. It's a radiation monitor of some type before the dilution --

MR. ORTHEN: Correct.

MEMBER BROWN: In the rad waste, of the rad waste tank or the line right as that --

MR. ORTHEN: Discharge line from the rad waste tank.

MEMBER BROWN: So, if the -- you would expect some set points that would say if I've got a higher level of rad waste or a concentration of radioactive material, then my dilution flow will adequately dilute.

That those will go off as well as then the flow -- you know, the flow alarm, whatever it is that says if I lost the flow. You've got two different things. Is that what you're getting at?

MR. ORTHEN: Right. You've actually got either a high rad or low dilution flow.

MEMBER BROWN: Okay.

MEMBER BLEY: And there will be some ITAACs on this after everything's fully complete?

MR. ORTHEN: Well, there's an ITAAC for certain, you know, design information for radiation systems that are installed. I don't know the specific ITAAC for that.

But, we have a Westinghouse representative here that maybe able to speak to that. But, -- and of course this is all -- all these programs for set point control and set point calculations and the whole manner in which liquid effluents are managed at the facility are all part of the offsite dose calculation manual.

Which will be available prior to fuel load for NRC inspection.

MEMBER BALLINGER: Okay. So, this calibration on the radiation monitoring would be a function of the isotopic content. And it --

MR. ORTHEN: Yes.

MEMBER BALLINGER: In the tank. And that would be accounted for?

MR. ORTHEN: Correct. And there's some more difficult to measure radio nuclides which you basically base on quarterly composites. And you scale based on those quarterly composites.

And once those analysis are in, you update the discharge records.

MEMBER BALLINGER: Thank you.

MEMBER BLEY: Well let's hear from Westinghouse.

MR. HARPER: Good morning. Zach Harper, Westinghouse. Just to reinforce what's being said here. There is an ITAAC as part of the design certification in Tier One that will -- it's essentially a pre-operational test of that radiation signal to ensure closure of the discharge isolation balance in Table 2.310-4.

And in addition to that, Chapter 11.2 of

the Design Certification also reinforces that there is a required preoperational test associated with that radiation monitor.

And upon a high radiation signal like what was said, the discharge isolation valve is isolated. An alarm sounds in the main control room. And the pumps are stopped.

MEMBER MARCH-LEUBA: That radiation warning, do you expect it to be like a gamma monitor outside the steel pipe?

MR. HARPER: That's right. And there's a depochtion of that, it's a cartoon of the radiation monitor that is in Chapter 11.5 --

MEMBER MARCH-LEUBA: Yes. But that won't even --

MR. HARPER: In Figure One.

MEMBER MARCH-LEUBA: That one will handle all the tritium. I mean, there is no chance of if you've seen the tritium concentration.

MR. ORTHEN: That's correct.

MEMBER RAY: But it is --

MEMBER MARCH-LEUBA: Is that principally or?

MEMBER RAY: It is the certified design we're talking about here, right?

MR. HARPER: Yes.

MEMBER RAY: Okay. Just to be sure.

MEMBER BROWN: You mentioned this. Don't leave Westinghouse. I think. Come on back from it.

You talked about the radiation monitor aspect out of the rad waste. You also mentioned that there was a flow from the dilution tank measurement so that you had -- that you had satisfactory flow to achieve the dilution levels.

And is -- is that monitored? I mean, is there a set point for that as well? Or is there a separate piece of instrumentation for it?

MR. HARPER: Again, this is Zach Harper, Westinghouse. So, yes. The flow measurement that is coming out of the effluent discharge, out of the WLS system is used as an input into PLS, the plant logic control system, as a calculation to ratio with the --

MEMBER BROWN: Okay.

MR. HARPER: The dilution flow. And that calculation that is performed by PLS is done after the detailed design of the site specific design is complete.

The reason why is because that the

dilution flow is site specific. But that --

MEMBER BROWN: It's not part of the original DCD. I mean, it -- right? I mean, this is a different system then what we certified?

MR. HARPER: The PLS is in -- is part of the certified design.

MEMBER BROWN: Oh, okay.

MR. HARPER: Yes. This however, the inputs, there's a boundary there that, you know, that some of the input comes from a site specific input. Some comes from a standard plant --

MEMBER BROWN: Okay.

MR. HARPER: Flow measurement. And that's the reason why that calculation and that part of the design is part of the detail that will occur, you know, prior to developing the final design of the site specific facility.

MEMBER BROWN: Okay. But when you're operating, there's an alarm -- there's something that tells the operators that something's not right in the dilution flow path?

MR. HARPER: Yes, sir. And there's a -- on a low one signal out of that dilution ratio calculation, there's an alarm that goes off in control.

On a low two signal, it isolates the discharge at the pump.

MEMBER BROWN: Okay. All right. Thank you very much.

MEMBER RAY: I'm sorry, did you have a question? I thought maybe you had a question? Do you want to pursue it further?

I just want to make the point that the certified design of course, if we have an issue there, we can pursue it. But, the issue of do we need to monitor for tritium separately from other isotopes is, I think, inherent in what you were asking.

MEMBER MARCH-LEUBA: That's correct. And I don't have a follow up.

MEMBER RAY: Okay. All right. It is 15 minute -- yes, did you ask then about anything else, Steve?

MR. FRANZONE: No. Not on that subject.

MEMBER RAY: We're satisfied on this.

MR. FRANZONE: Okay.

MEMBER RAY: I was going to say, and tell me if you have something else you want to add, that it's a quarter until. Again, because of the circumstances of it being the second day, we're

going to hold to one hour.

But I was going to break for lunch now and come back at a quarter hour earlier then is shown on here. Which means a quarter to 1:00, to try and make sure we don't overrun this afternoon.

MR. FRANZONE: That's fine.

MEMBER RAY: Is that all right with you guys?

MR. FRANZONE: Yes, sir.

MEMBER RAY: All right. And maybe we'll beat the crowd to the cafeteria, those of us who go there. So, we'll recess then until 12:45.

(Whereupon, the above-entitled matter went off the record at 11:44 a.m. and resumed at 12:45 p.m.)

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

(12:45 p.m.)

MEMBER RAY: The session will resume now, at this time. And we will turn to the Applicant. I believe, Steve, you are going to begin with 3.5.

MR. FRANZONE: Correct. Good afternoon, everyone. We appreciate the opportunity.

I am going to let each of the gentlemen introduce themselves but the three areas we are really going to cover are the external missile evaluation, the foundation input response spectra, FIRS, and then the soil structure interaction analysis.

MR. LASKEWITZ: Good afternoon. My name is Bernard Laskewitz. I am a structural engineer at Westinghouse Electric Company.

MR. OSTADAN: Hi, I'm Farhang Ostadan with Bechtel Corporation.

MR. TUNON-SANJUR: I'm Lee Tunon-Sanjur. I am a civil engineer at Westinghouse.

MEMBER RAY: He's been here before but like me, I forget.

MR. LASKEWITZ: Okay, today I would like to talk about the hurricane missile evaluations

which we conducted for Turkey Point and I would like to point here first to the code requirements and provisions which are in place to make us evaluating for hurricane missiles.

As you can see here, we have the General Design Criterion, GDC 1, which basically requires us to evaluate safety-rated structures for missiles; and GDC 2, which requires us to design for natural phenomena, which a hurricane is; and GDC 4, which is the specific missile evaluation requirements for external-generated missiles. Next slide.

So, the code requirements and provisions what we have in place that is like guidance from the NRC, which is Reg Guide 1.142, which is Safety-Related Concrete Structures for Nuclear Power Plants; Reg Guide 1.76, which has requirements for the Design-Basis Tornado and Tornado Missiles; and also Reg Guide 1.221, which is the Design-Basis Hurricane and Hurricane Missile requirements for nuclear power plants from 2011. That is a little bit specific to Turkey Point, which is not in the certified design required and what the DCD Rev. 19 had.

So, the missile spectrum. What we evaluated for Turkey Point is three missile pads.

One is a massive high-kinetic-energy missile, which deforms on impact, which is the so-called automobile. It is a 4,000-pound automobile. I will talk about this a little bit more in the next slide.

A rigid missile that the purpose is to test the penetration resistance.

And a small rigid missile, which is sufficiently sized to pass through any openings in the protective barriers.

And then the missiles are capable of striking in all directions. This is how they evaluated them. And barrier design should be evaluated using normal impact to the surface, which is typically leading to the most conservative design.

And all external missiles for hurricane are enveloped by the tornado missiles in the vertical direction but not in the horizontal direction for Turkey Point, specifically. Next slide, please.

So, this table shows here a summary of the AP1000 design basis tornado missiles and their associated weights and speeds, as well as the Turkey Point 6 and 7 hurricane missiles as a comparison.

The table above indicates that the

missile weights are pretty much the same between the tornado missiles in the certified designed and the hurricane missiles in the Reg Guide 1.221. However, the missile speed is different.

So, if the missile speed and tornado is 105 miles per hour, which is roughly 35 percent of the maximum wind speed, what we have in our certified design, and the vertical speed is a fraction of that.

The hurricane missiles, there is in Reg Guide 1.221, a table which associates the wind speeds, which is, as we have heard yesterday, it is only 260 miles per hour wind speed for Turkey Point for a category 5 hurricane. However, the missile speeds are higher because of straight line wind behavior. So, the idea is that a tornado can accelerate a missile like in this vortex but cannot have the momentum transferred like with straight line winds. So, accelerates more and more.

So, therefore, the missiles in a hurricane event are typically a higher speed with the same wind speed as a tornado.

As you can see here, also just as a quick comparison, as I indicated, the vertical missile speeds for hurricane missiles are smaller

than or lower than the missile speeds for tornadoes. However, the missile speeds in a horizontal direction, especially the automobile, is 180 miles per hour, which is substantial.

Okay, next slide.

So, from the detailed design requirements, what we need to follow for our concrete structures, we need to follow ACI 349-01, Appendix C, which has special provisions for impulsive and impactive loading effects.

So, we use specifically C.1.4 for impactive loading that be defined as time-dependent force and function or a pressure. And this is for used for the automobile missile.

And we use energy balance techniques as prescribed in Chapter C.6.2. It is used for the pipe and the sphere missiles.

In accordance with ACI Code, allowable ductility factors of 10 for flexure and 1.3 for shear are utilized. That means we are checking the structures for a specific ductility. It means we allow local plastic behavior of the structures per licensing basis and the applicable codes. Next slide.

For the automobile missile impact

evaluation, we have also chosen to use a center impact besides an edge and corner impact, which maximizes the out-of-plane shear behavior. And for the center impact, we evaluated one-way as well as two-way shear per ACL 349 and the wind load and the automobile missile loads are as well considered for that case, as well as for the pipe and the one-inch sphere.

And the dynamic increase factor was utilized per Reg Guide 1.142 and for specifically when they reach a dynamic load factor of more than 1.2. It is a factor which is like a strength increase factor for a dynamic impact. As you may know, if you have a dynamic response of a system, if it is highly dynamic, then the strength increases and the code allows to use that.

For the edge and corner impact, we used dynamic analyses using a finite element code called ABAQUS. And with our standard AP1000 NI05. NI05 means it is a nuclear island; 05 means that is the meshing. It is five-foot meshing and being refined in the areas of impact and mesh.

And this cartoon shows you the locations of the corner and edge and the center impact. Again, the corner and the edge impact are basically

maximized in out-of-plane shear behavior and the center impact would maximize the flexure behavior. Next slide, please.

So, for the automobile missile impact evaluation, we used a dynamic time history analysis for the mid-impact on the center of the wall panel that was basically like a single degree of freedom system, not the ABAQUS. And the flexure and shear strengths are evaluated per ACI 349-01.

And then nonlinear finite element analysis were performed to investigate the shear behavior for the corner and edge impacts.

And the critical walls were based, the selection of the critical walls were based on the thickness and the reinforcement ratios and their location and span distance to basically maximize the out-of-plane shears for the flexure behavior to have mostly all locations around the perimeter and evaluated.

The finite element analysis were performed, as I indicated to further investigate the shear behavior of the structures and the results have shown that the out-of-plane shear behavior stays essentially elastic, which actually is a very good margin for the structure. So, it is very

robust.

So, next slide, please. So now this is the conclusion. So, we evaluated the three hurricane missiles. That means the automobile, and the pipe, and the sphere. And we evaluated them for the horizontal impact on concrete walls and the automobile missile was evaluated additionally to the center impact for edge and corner for the critical walls.

And the conclusion is that the certified design of the AP1000 concrete walls is acceptable for site-specific hurricane missile impacts at the Turkey Point site.

That concludes my presentation. I would be happy to answer any questions.

MEMBER SKILLMAN: Bernard, you mentioned that the meshing is on five-foot centers. It was NI05. What would the meshing be as you considered shear on the corners? Would you drop that down to a foot or six inches?

MR. LASKEWITZ: Well, it is actually less than that. I think we went up to somehow like one-tenth of potentially one foot. So, basically six inches, I would say. So, we have also significant refined meshing in that area to drop it

down to capture the out-of-plane shearing correctly.

MEMBER SKILLMAN: Okay, thank you, Bernard.

MR. LASKEWITZ: Thank you, sir.

MEMBER RAY: Anything else? Okay, if not, we will move on.

MR. OSTADAN: I am Farhang Ostadan, Bechtel Corporation. I have a short presentation on 3.7.1.1. We are going back to seismic.

Before lunch, you will notice that the presentation on seismology clearly showed the seismicity at the site is very low. And the seismic hazard at the site was represented by ground motion response spectra, GMRS, have only a PGA of 0.06g.

In spite of this low seismicity, it was decided to perform site-specific seismic soil structure interaction analysis so that we can obtain the site-specific seismic response of the plant. We can compare it with the responses in the certified design. This was mainly none not on account of the seismic load but because the soil profile, the site profile is somewhat different from the generic profiles that are used in certified design.

Now, in doing so, we have to now develop input for seismic soil structure interaction

analysis. This input is defined as FIRS, foundation input response spectra, which has to obtained from the site column at the elevation of the foundation of nuclear island. As you can see on this slide, that elevation is 96 feet.

In amplifying the hard rock motion that was presented, again, before lunch, to obtain the response at the first horizon, we recognize that the site profile in the upper elevation at this nuclear island is somewhat different from the from the nuclear island because of the foundation design and design for the concrete fill and grouting.

Therefore, in order to develop FIRS, we identified two site columns. These are represented by two red lines, vertical lines. One is called NI, adjusting to the nuclear island and the other one is labeled FAR, somebody stands far away from nuclear island.

We obtained a response from these two columns and then we enveloped it to the conservative site to obtain the input motion for soil structure interaction analysis.

Development of the FIRS is consistent with the development of GMRS that was presented earlier. It follows NUREG/CR-6728 Approach 2A and

except that now we have one more profile to deal with. But otherwise, the procedure is the same. Next slide, please.

In order to amplify the hard rock motion to the horizon of interest, the amplification is to model the dynamic site properties. This is the profile adjusted to nuclear island, NI and the red line represents the best estimate shear-wave velocity. The figure on the left is the upper 800 feet and the figure on the right is the total column that extends all the way to 12,000 feet.

To consider the variation in the soil properties as measured, as well as the thickness of different layers in the site, these profiles are typically randomized or simulated and it is typical to simulate 60 profiles from the best estimate. So, the gray lines you see adds up to 60 profiles that are used for the purpose of amplification. Next slide, please.

The amplification is performed for every one of those 60 profiles for both columns, NI and FAR. As was mentioned in the morning, it has to be performed for two levels of input motion. One is the hard rock motion with the uniform hazard spectra of ten to the minus four. The other one is at ten

to the minus five. And in doing so, we need to consider the aggregated spectra, high frequency and low frequency that was also presented before lunch, in order to avoid over-driving the soil column for nonlinear effects.

So, the figure on the right shows the spectral amplifications at two horizons; one at the finish grade 25.5. The other one is at FIRS horizon, minus 16 feet for high and low frequency. The figure on the left shows the similar results for ten to the minus five.

Once we have the response at these two levels, we will follow Reg Guide 1.208, obtain a design factor from which we can obtain the FIRS response structure.

If we go to the next slide, please. This is the end result. The blue line is the site-specific FIRS. The solid line is the horizontal spectra. The dashed line is the vertical spectra. And as you can see, again, the intensity of motion is fairly low.

We also recognize there is a requirement for minimum input motion per 10 CFR Appendix S that 0.1g has to be used as a minimum. And this is often combined with broadband spectrum and typically

Reg Guide 1.60 is used. So, therefore, the two red curves that you see is the Reg Guide 1.60 response structure scaled to 0.1g. One is horizontal and the dashed line is the vertical.

This because of the minimum requirement, we ended up enveloping the Reg Guide 1.60 with the site-specific motion, which in practical terms is actually Reg Guide 1.60 scaled to 0.1g. And that motion was adopted as SSE for this site.

You can clearly see the level of conservatism when they adopted SSE versus the site-specific motion for the soil structure interaction.

The other element that is needed for soil structure interaction is development of site properties that is compatible with the level of shaking to take into account the nonlinear behavior of the soil here.

And if you go to the next slide, that was also performed at this time for the Reg Guide 1.60 SSE. And the three profiles you see on here are the three shear-wave velocity in the upper thousand feet that represents the best estimate upper band/lower band that was turned over for seismic soil structure interaction.

I think this is the last slide that I

have. I will be happy to answer any questions before I turn it over to my colleague.

MEMBER RAY: Anyone with a question? Thank you.

MR. TUNON-SANJUR: I'm Lee Tunon-Sanjur of Westinghouse.

We took the work that Farhang just did and put it into our structural models. The soil structure interaction analysis is the tool in which we checked that the seismic response at Turkey Point is enveloped by the AP1000 design.

The AP1000, as you saw, Farhang had to conservatively increase the site-specific response to 0.1g, Reg Guide 1.60. The AP1000 is designed to 0.3g, three times as much as what the site-specific response was scaled up to.

We also do nine different soil conditions as an envelope of the design; three soil conditions for different soil stiffnesses, three rock conditions that take it all the way through hard rock, and then we also do three conditions in which we have hard rock at the foundation bottom, along with backfill that would support it. So, all of those nine conditions get enveloped in the design using 0.3g input.

So, we were fairly sure before we started this work that we had a good chance of enveloping the design. However, because of the intricacies of the foundation work that was done, the work was performed.

So, the SSI analysis that we evaluated the effects of the finite element mesh size and its adequacy. Because of the intricate features, we had to use smaller elements, and I will show you shortly the model, in order to capture all those features. We also evaluated -- incorporates the effect of the lean concrete fill, variations of the soil properties, and adjacent structures. Next slide.

Here you see a plan view of the Turkey Point Unit 7. As you see, the slurry wall surrounding the nuclear island in the middle and around between the slurry wall and the nuclear island you have engineering backfill. Next slide.

Then you see a cross-section AA of that plan view and you see the features that have been talked to in the previous presentations. We have the slurry wall supporting the nuclear island being over a concrete fill and also a grouted layer being surrounded by the engineering backfill.

MEMBER BLEY: You didn't include that

extra grouted layer below that. Does that make a difference? I forget what they call it. The extended grouted area.

MR. TUNON-SANJUR: I'm just showing the immediate sections. We actually go -- the soil structure interaction actually goes very deep into all the other layers, not just the extended grouted layer but also some of the other soil layers that don't have as much effect by that time.

MEMBER BLEY: Okay.

MR. TUNON-SANJUR: Next slide. This is the Fine Model, a 2D Fine Model in which we can capture most of the features of this particular Turkey Point design. As you see the lean concrete fill. We call it site rock but it is really the extended -- below that is the extended grouting layer and then we capture all the other layers.

We compared -- this is a very refined model that we didn't use in the AP1000 design. We had a coarser model. So, we took some -- we compared this mesh to the one that we used in the AP1000 generic design. Any increased factors due to the various features of this condition versus the AP1000 were factored into the lower response spectra that we will show you shortly.

I have a couple of slides in summary and conclusions. I'm not really going to go through it. Really, I will show you in the graphs the point that the AP1000 design amply envelopes the site-specific response.

MEMBER SKILLMAN: Lee, would you go back a slide, please?

MR. TUNON-SANJUR: Sure.

MEMBER SKILLMAN: At the upper boundary of this image, I see a minus 401 on the far left and what I believe is a positive 364 on the far right. And I see nuclear island minus 13.94. What do these numbers represent?

MR. TUNON-SANJUR: Those are the horizontal positions. So, the distance --

MEMBER SKILLMAN: From the design cert orientation?

MR. TUNON-SANJUR: This is actually just the extent of the model. And so, we are taking it from the center of the nuclear island at position minus 13 all the way to minus 401 and then all the way to plus 364.

So, this is the extent of the structural portion of the soil structure interaction. A soil structure interaction is divided into a structural

portion and a soil portion. In order to capture all the features that were important in Turkey Point, we had to create a structural model that not only had the structure itself but also the concrete fill around it and the lean concrete fill. And we had to take it far enough away from the foundation so that the effects at minus 401 we are saying are not quite as important.

MEMBER SKILLMAN: Okay, thank you.

MR. TUNON-SANJUR: So, the conclusions that we have is we accounted for, of course, all the variations in ranges of soil. We accounted for the mass size. We brought in the envelope and I will show you shortly. What the graphs will show is that, again, the AP1000 generic design envelopes the site-specific. Next slide.

So, this is a model for a 2D model in which we investigate the interaction between the Seismic Category II adjacent structures and the nuclear island. So, on the left-hand side, you will see a small stick. That is the Annex Building Seismic Category II structure and you see the larger stick in the middle, which is the nuclear island.

On the right-hand side, you will see two curves, one horizontal and one vertical. The solid

line represents the AP1000 generic design and, as I said, it is 0.3g for nine soil conditions, and in the lower curves, the red and the dashed curves represent various stages of studies that we did for -- the analysis that we did for the site-specific Turkey Point design.

And, as you can see, both the vertical and the horizontal have the AP1000 amply envelopes.

And this is a plot that is plotting the foundation response spectra at the bottom of the Annex Building that would be used for building design. What we actually used for building design of the Annex Building is the bold black line. And yet, for Turkey Point, this wasn't a generic design type of application. We could have used a lot less reinforcement for that because it has these a lot less seismic forces.

Okay, next. So, the results of the -- one of the things that we do check in the adjacent structure of 2D models is that the relative displacements between the two buildings are sufficient and meet the DCD criteria, which is two inches -- the relative displacements cannot be more than two inches at the foundation and no more than four inches above the foundation.

So, we check the Turbine Building 1st Bay foundation and then the top of the foundation. Again, the Annex Building foundation, and at the top of the Annex Building.

We performed Seismic Category II SSI sensitivity analysis and the results -- I don't have the results, the actual results but they are significantly less than the four inches required and the two inches required. Next slide.

Then, we are going to compare the seismic response in the nuclear island itself. This is the typical model that we used for the generic design. The only thing about the Turkey Point is after we completed the response in this model of Turkey Point, we then increased that response, based on the adjustment factors that we have developed using the 2D Fine Model that I showed you earlier.

I'm going to show you just three locations out of the six typical locations of the nuclear island. Next slide. So, here we see at the containment internal structures elevation 99, this is the flow response spectra that we used to design, for example, the containment vessel and some of the other structures.

Again, you see the black bold line is

the AP1000. The red line, along with some sensitivity studies in dash is the site-specific Turkey Point. And you can see at this location there is this ample margin.

Next slide. And I won't show you all of them. I'm going to show you just three. Here is a point in yellow circle in the upper left graph of the location and the containment internal structures. You can see the different for both.

At the right-hand top is the north-south direction, the east-west direction, and finally, at the bottom right is the vertical response. And as you can see, the generic design does envelope the site-specific.

Finally, last comparison. At the top of the Shield Building, you can see the generic response, again, envelopes the site-specific.

So, with that, the final seismic conclusions. As you can see from the graphs, the AP1000, the Turkey Point Units 6 and 7 site-specific response spectras are enveloped by the AP1000 design, with margin at the key nuclear island and SCII adjacent structures.

That's all I have.

MEMBER RAY: Okay. Again, questions?

Thank you very much. Steve, are you done then?

MR. FRANZONE: We are done.

MEMBER RAY: Okay, we are done at 1:15. So, we are a half hour ahead at this point in time.

We are going to have staff come up and give us their take on this same area.

I will mention I think everyone noted already that we have gotten sent to us a couple of IRAs by Peter that were referred to yesterday and we were having discussion concerning -- well, I guess it was this morning, come to think of it, concerning assumptions about ocean level.

It will get sorted out eventually. You can go ahead and introduce yourself, if you would care to.

MS. REYES: Good afternoon, everyone. I am Ruth Reyes, Project Manager for the review of Turkey Point Units 6 and 7 COLA, Chapter PM for Chapter 3, Design of Structures, Components, Equipment, and Systems.

I have listed here all the sections on Chapter 3 but we will only be presenting Section 3.5 and 3.7.

For 3.5, the lead reviewer was Jerry

Chuang, here beside me from the Structural Engineering Branch. And with that, I am going to let Jerry start with this presentation.

MR. CHUANG: Good afternoon. My name is Jerry Chuang from Structural Engineering Branch of NRO. Today I am going to present the FSAR Section 3.5 Missile Protection. The objective of this review is to assure design adequacy of the fill or thickness against external missile effects.

In Turkey Point, FSAR Section 3.5 is incorporated by reference with supplement Turkey Combined License Item 3.5-1. If the size of this condition exceeds the standard design basis, then the applicant should perform site-specific safety analysis.

In 3.5, the hurricane missile speed cannot expect the standard design by 87 percent. Based on Reg Guide 1.31 titled Design Basis Hurricane, Wind, and Hurricane-Borne Missile Velocity.

And this is recommended by the Reg Guide for NUREG/CR-7004, which present document table of all missile types velocity, hurricane wind velocity. So, as a result, we hold onto velocity, missile velocity, auto missile or pipe missile exceeds the

standard design basis. However, the vertical velocity has enveloped standard design.

Therefore, the applicant followed the DCD design basis for allowing the missile impact. It is identified most energetic missile, which is auto missile selected from that Reg Guide. This missile included like a ball and pipe missile as surrogate recommended by the Reg Guide 1.221.

And auto missile was selected because it is most energetic.

Furthermore, the building selected is the Auxiliary Building because the Auxiliary Building wall thickness is less than Shield Building wall. For example, it is only 20 to 23 inches as compared to 36 inches of the Shield Building.

So, the analysis of Turkey Point on the missile impact focused on the auto missile at the speed of 180 miles per hour hit the vertical wall of the Shield Building.

MEMBER RAY: It's best to push the microphone back, if you have to.

MR. CHUANG: So, staff reviewed the DCD analysis and found that the DCD is the so-called equivalent static method, which is allowed by the standard review procedures. In this method, only

the simple hand calculation are required.

Furthermore, it is given a high degree of conservatism. For example, each wall panel selected was from a single free body supported by the full beam. Okay? And those beams support assume vision. This means it is very conservative.

Secondly, to use the equivalent static method, you need to increase the so-called dynamic load factor. And in DCD, the factor is assumed true. Realistically, this dynamic load factor should be right between one and two. And the reason being that you have a fixed load, physically, however, in the dynamic situation, you still have kinetic energy. So, you convert the kinetic energy into strength energy and add that to influence the information. Therefore, the surface load must be higher than the below between one and factor of two. In fact, the upload did an analysis for all selected wall panels and found that load factors vary from 1.0 to 1.4, which is much less than 2.0. So, it means that the DCD is very conservative.

And the staff reviewed focus on the detailed analysis not only what have done by the DCD but also what other staff put in that is required by the staff. And this report from Revision 1, 2, 3 is

basically using the hand calculation and is in the form of the attachment in the response to ERI 6544.

And in addition, the Applicant also performed the Turkey Point using 3D dynamic finite element analysis method because some of the situation really do not meet the design requirements.

As we can see there, this method is not precise without the addition --

CHAIRMAN STETKAR: Please be careful with your papers. It hits the microphone.

MR. CHUANG: Okay. The staff performed several others on this finite element program. And the staff used a three-dimensional finite model that construct in the immigration of 3.8.4 the other Seismic Category I structure. The difference is that they cut off the bounding condition. This is from the base, they cut from this up to the grade level. So, the staff ordered it and then find out that bounding conditions a little bit conservative. So, it is acceptable.

And before we performed the detailed review in this technical report, we request the Applicant to benchmark the finite element program with the experimental program performed in the

technical revision.

And Applicant was very responsive and they performed the comparison between the prediction of the finite model and the extreme measure data and they find it very, very close. Therefore, we have the confidence that this computer program is really a good one and is not a black box.

MEMBER SKILLMAN: Jerry?

MR. CHUANG: Yes?

MEMBER SKILLMAN: Where was this confirmation conducted?

MR. CHUANG: The confirmation from the Applicant at Westinghouse site.

MEMBER SKILLMAN: You said you confirmed the code against --

MR. CHUANG: Confirmed their program, not the code. Yes, their program is adequate, correct.

MEMBER SKILLMAN: Okay, thank you.

MR. CHUANG: And they can predict the measurement of the deformation at the age of the wall panel compared with the measure in either, and the difference is very small, less than ten percent, which is reasonable.

Okay, so, and also the Applicant do two

things. They used linear material property, linear elastic and also the nonlinear elastic property. And the result was just two model predictions are quite the same. The implication is that under the auto impact actually the concrete wall is still remained in elastic.

Okay, so the input to this finite element program is 4,000-pound automobile with the front side 6.6 feet by 4.3 feet and the dense is 16.4 but that doesn't matter because the contact area is the rectangular surface contact. The next slide will show the loading. Okay? Can we go to the next?

Okay, this is the living function of ten following the DCD. This is the extended curve of ten by the experiment performed by National Oak Ridge -- Oak Ridge National Lab, where they used the rear of the model impact over the concrete panel. And what they got was this curve.

Notice that the delay is very small. It is only 8 milliseconds. And this is, of course, in real order. It is not rigid, perfectly rigid. We have some flexivity. That is why you have 8 milliseconds. We can expect that the more rigid the impact relation will get shorter.

Okay, so the Turkey Point case, we just scale up the curve from the DCD up about 87 percent. So, this is the history we use an input to the finite and then prove it.

Okay. And then the Applicant also followed the DCD by choosing seven critical walls, wall panels. But in addition, we requested two more within that model. So, a total of seven walls were selected to perform time history evaluation.

And each panel also, as Applicant mentioned, evaluated the center, corner, and the mid-edge strike locations.

Okay, previous slide. Okay, so this is what I mentioned, a total of seven walls were selected because I have a table here which is privileged information and I am not allowed to show. And in there there are six vulnerable locations in the Auxiliary Building and each wall they performed center impact, corner impact, and then mid-edge impact. And for a given impact, you can imagine the possible failure surfaces. One is the failure of surfaces on the four sides around the periphery of the contact surface. And then secondary, there is a possibility that you have a two-way punch-through along the beam support site. And finally, the third

option that you can have one-way you have local punch-through. So the ACI code, which is the license basis, must request you need to evaluate all possible sites that actually met. In other words, the shear stress in this area. And those stresses must be below the capacity. So, that is the design criteria.

So, next. So, then what the code ACI 349 specifications says that the same design reinforced concrete shear capacity based on ACI 349 Section 11.12.2 specifies that for the concrete, the one-way beam reaction the capacity is 112 psi with the two-way beam reaction then is doubled to 224 psi.

And the Applicant evaluates all cases and calculate the demand for all cases and find out that all demands were less than the capacity. Some is 112, another is 224.

Therefore, we concluded that the Applicant used the finite element dynamic time history analysis, which shows that one-way shear stress demand at the critical section is less that the shear capacity permitted by the ACI code. And one-way beam response shear capacity is 112 psi allowable based on ACI Code.

The staff conclude that the Turkey Point design is adequate against hurricane-induced missile impact. Thank you.

MEMBER RAY: Any further questions? Thank you.

MS. REYES: Okay, if there are no questions, we are going to move to the next section, which is 3.7. And 3.7 is seismic design. And for that section, I have here from the staff Pravin Patel. Pravin.

MR. PATEL: Good afternoon. My name is Pravin Patel, Office of New Reactor. I have another reviewer also along with me, Alissa Neuhausen, also from Office of New Reactor. And I have two consultants sitting in the audience also named Carl Constantino and Tom Houston.

I will present three issues. Issue means it is a departure, basically, from the DCD; what is the difference between DCD and Turkey Point related to 3.7.

The first issue is the Design Ground Motion Response Spectra, SSI soil profiles and input motions. That is the topic. Second topic is the Seismic Category II or I interaction with the non-seismic and seismic building Category I. The third

issues is maximum relative displacement between the nuclear island and adjacent building foundation considering the effect of force-related subsurface waves.

Issue number one, engineering backfill is required to raise the plant grade to be consistent with the DCD soil profile. The plant grade is raised due to the excavation of muck on the top ground surface and to allow for excavation below foundation.

The Applicant developed what performance-based seismic response spectra, which is called PBRS from now on, and the ground motion response spectra called GMRS is following the guidance of Subsection 5.2.1 of the ISG-017.

The PBSRS is the same as the design response spectra, DRS, as mentioned in the application. Next slide please.

The primary difference between the PBSRS and GMRS is that the PBSRS was developed at the plant finished grade and includes the engineering backfill effects, while the GMRS is for ground motions all over Turkey Point Units 6 and 7 site, without considering the building or field characteristics. In other words, it is called free

fill ground motion.

The ground motion is developed at -- ground motion response spectra is developed at minus 35 feet, which corresponds with the uppermost competent rock layer elevation. The PBSRS is developed at the plant at 25.5 feet, which includes the Category I and Category II fill material and the foundation input response spectra is developed at minus 16 feet, which is below the nuclear island, corresponding to the bottom of the foundation.

Next slide, 64, please. This slides shows the staff confirmatory analysis result, which is what you saw from the Applicant also. The comparison of the staff FIRS, foundation input response spectra, and the Applicants FIRS shows that both FIRS are enveloped by Reg Guide 1.60 spectra anchor at 0.1g and AP1000 certified design spectra. The horizontal axis is the frequency in hertz and vertical axis is spectral acceleration.

Next slide please. The resolution to this one, the staff performed confirmatory site response analyses using only the near-field site profile developed for the nuclear island, along with the same input response spectra used the Applicant. The Applicant used the envelope of the near-field

and far-field, which you saw in previous presentation by the Applicant.

The staff used estimated values of stiffness and damping coefficients for the proposed fill material to develop FIRS for the site profile.

Next slide it will show the near and far fill locations, which also was presented by the Applicant.

The staff developed FIRS spectra at the foundation level, elevation minus 16 feet to check the minimum required peak ground accelerations requirement of 0.1g horizontal direction as applied by 10 CFR Part 50, Appendix S.

Conclusion, the Applicant analysis for the design basis FIRS are enveloped by the AP1000 CSDRS.

Slide number 66, please. This slide shows the difference between near-field and far-field developed for the site. Near-field includes this 19-foot lean concrete layer beneath the foundation.

Slide number 67. The second issue is that the Applicant performed supplemental subsurface investigation at the site, resulting in a change of the geotechnical site characterization. In updated

analysis, the Applicant used an approximate process to update the soil profiles and include the grouted rock layer in the excavation. The grouted layer extend from the base of the concrete fill elevation to minus 64 below the foundation.

Slide number 68. Sensitivity analysis was performed to show that the updated profile will not significantly change the computed seismic demand. The site-specific SSI of the facility was performed to the envelope FIRS and Reg Guide 1.60 scaled to the 0.1g. As mentioned before, Applicant mentioned that AP1000 at 0.3g, which is three times.

Both original and updated profiles are enveloped by the 10 CFR Appendix S requirement to minimum seismic input 0.1g horizontal peak ground acceleration at the foundation level.

Slide number 69. This slide shows the initial and updated FIRS compared to the Reg Guide 1.60 scaled to the 0.1g, where FIRS profiles are enveloped by the spectra. So, the updated one is the red color FIRS and the initial was the black line FIRS. And Reg Guide 1.60 is 0.1g, which is the highest curve on here.

Slide number 70. The Seismic Category II or I interaction is another issue. The site-

specific modeling and analysis of the seismic Category I and Category II structures considers the effect of postulated subsurface voids.

The Applicant analyzed the potential impact on the stability of the overlying soils, structure foundations, and the seismic Category II interaction of the Reg -- sorry, of the SUP Guidance 3.7-2.

Slide 71, please. The Applicant postulated a maximum 20-foot spherical void based on the boring spacing for the grout injection. Boring spacing was mentioned earlier in the morning. It was a 20-foot spacing.

The Applicant performed a conservative 2D pseudo-dynamic analysis considering the presence of 20-foot diameter cylindrical void, as discussed earlier in 2.5.4 and shown in the figure the void was postulated beneath the nuclear island to learn the Seismic Category II or I interaction.

The void was also postulated beneath the Turbine Building, which is a Category II structure and also a non-circulated structure. The Turbine Building is Category II and Category I structure also postulated as the Category II structure.

We say the conservative analysis has 20-

foot cylindrical void that postulated is a much smaller void than that shown in figure -- the 20-foot cylindrical void evaluations demonstrate the seismic Category II structures will not interact with the seismic Category I structure.

Slide 72, please. This issue is related to maximum relative displacement between nuclear island and adjacent foundation.

The Applicant computed the probable maximum relative displacement between the nuclear island and adjacent building foundations. The seismically-induced lateral deformation to the soils surrounding the nuclear island must prevent the contact between the adjacent structure.

Slide number 73. The maximum relative displacement computed by the Applicant is 0.05 inches at the foundation and 0.174 inches at the top structure. The computed displacement between the NI and the adjacent building is less than 2.0 inch gap required per the DCD.

The interaction between nuclear island and adjacent buildings is not a concern.

This concludes my presentation.

MEMBER RAY: Thank you. Any questions? Hearing none --

MEMBER KIRCHNER: I have one.

MEMBER RAY: Okay, please.

MEMBER KIRCHNER: What is the sensitivity in general, since you identified as an issue the soil conditions like what is it, Category I fill and Category II fill? And how does that impact like your last analysis of the relative displacements?

How critical -- how sensitive is the calculation to what you assume about the soil and the fill? I mean these are pretty precise calculations, 1.74 inches, 0.05. So, I'm just curious how sensitive is the result to the assumptions on the soil and fill that was used?

MR. PATEL: Yes, the Applicant mentioned that they did the 2D and then used the factor to do the SSI analysis and used all the soil layers. And the soil layer has the properties that what properties are fit into the calculations, the layers. And based on it, the computation assures the displacement to the grade. So, that is where you get the displacement for the structure.

MR. TUNON-SANJUR: Hello. This is Lee Tunon of Westinghouse. Because of the margins that we have, as you see as it was reported, you have

only 0.05 inches at the foundation, when the limit is 2.0 inches. Even if we were to double the stiffness or cut it in half, and then say it raised to 0.15 inches, you still would have a lot of margin.

So, depending on what type of Category II fill structure you would have, yes, there would be some differences in displacement but the margin is so wide for Turkey Point that it is not an issue.

MEMBER KIRCHNER: So, how sensitive is that Cat I and II fill to say inundation, flooding and such, and how would that change the response?

MR. TUNON-SANJUR: So, Cat I and Cat II really don't have to do with the properties of the soil. I was mostly talking about the variation. It really has got more to do about the testing you do for that fill. So, Cat II and Cat I could potentially, in theory, be almost the same similar properties.

As far as the flooding, we do analyze up to the groundwater level up to grade. So, we account for that variation and flooding. And based on the AP1000, in which we varied the water level elevation of the soil layers, it really has maybe a

one to two percent change. And here we are talking about responses that are one-fifth of the limits. So, it really would not change the conclusions.

MEMBER KIRCHNER: Thank you.

MEMBER RAY: Anything else? Thank you very much.

MS. REYES: If there are no more questions following the presentation of 3.7, the staff concludes its presentation on Chapter 3. Thank you.

MEMBER RAY: Okay. All right, it is ten minutes to two. And a break was scheduled for 2:30 but we did start 15 minutes early this session. And the Applicant is up next to discuss Chapter 13.3, initially.

Before we break here, though, take the scheduled break for this afternoon, I want to explore something. This being a subcommittee meeting, we have to try and do things sometimes that haven't been planned ahead of time.

The presentations, as I read them anyway, dealing in Chapter 13, Emergency Planning, have entirely to do with on-site emergency facilities, tech support center, and so on. And particularly with the staff, they are quite brief.

Yesterday, we had a discussion about population density exceedance. That is, exceedance of a guideline, not exceedance of a regulation but exceedance of a guideline numbers. And there is some potential interest in the offsite emergency planning, which is, of course, more affected by population surrounding the plant than is the on-site facilities but that currently isn't part of what is going to be discussed this afternoon.

I wanted to say to the members there is a very, very lengthy discussion of the offsite emergency plans that appears in Chapter 13 of the staff's ASE and elsewhere, I am sure, as well, but that is where I go to look first. And it points out that the Applicant has submitted an emergency plan that does integrate the operation of a four-unit site; that is, the two existing units and these two units that are proposed.

The staff, in its conclusion, which includes a number of license conditions and ITAAC related to offsite emergency planning, reaches a conclusion only with regard to the two new units, because that is what is being discussed here. Nevertheless, it is at a location where there existing units and it is an area that has this

population exceedance.

Now, I say all of that because when we come back, the staff will be here talking about emergency planning and I know some are interested in the connection, if any, between population and the offsite consequences or compliance with the guidance because, as I said in the very beginning, we are having to deal here with an exceedance that we haven't done before. And so I want to make sure that because the current plan, anyway, is to come back and in two hours at the full committee within two or three weeks, we will be in a position we can write a letter. So, there is no point in us not attempting to get all the information now that we can within the time available.

But I want to point out anyway that there is this very, very extensive discussion by the staff of the offsite emergency planning. It has these features that I mentioned to you just in summary. You can take a look at it yourself and I do see that there may be interest in connection with offsite emergency plans relative to the issue of population exceedance.

At this point, I can't see any way to address that here because to try and talk about the

offsite emergency planning, as I say, it is an enormous and very complicated discussion in the ASE. It involves offsite agencies and so on. We couldn't ask the Applicant to in any way summarize that at all or draw any connection between the evacuation planning and the population issue.

But those are the facts. I want to make the members aware of them. When we do come back, we will be in Chapter 13. I don't believe it is intended. I haven't asked them but I don't believe it is intended to talk about offsite emergency plans. But in any event, if anyone wishes to do so, I would ask you to make a quick review of the Chapter 13 in the ASE so that your questions can be more specific to the issues addressed.

I have tried to tell you what it says in very, very summary terms. Like I say, there is a four-unit emergency plan that has been submitted. There are a lot of things that are yet to be satisfied as far as the COLA for these units is concerned. And at the end of the day, the staff's conclusion is based on these two units, not the four units. But it does address the four units in terms of the fact that they would exist.

I hope that wasn't too confusing but I

thought I needed to do something, given that it is now two o'clock on the second day and I need to give you a chance to decide if there is something we have to have that we don't have to put this issue to rest. We will be doing so, of course, at the full committee meeting, we think, in September. Okay?

Now, with that, we will -- let's see, we have got scheduled here a 20-minute break. I think everybody would be happier to have a 15-minute break. So, we will recess for 15 minutes and be back at ten minutes after two, please.

(Whereupon, the above-entitled matter went off the record at 1:55 p.m. and resumed at 2:12 p.m.)

CHAIRMAN RAY: Okay. We're beyond our scheduled return time because we were doing other things. So we're now to the last section schedule for today, and it's the applicant's turn to talk about emergency planning.

MR. FRANZONE: Good afternoon members of the ACRS. Again, this is Steve Franzone, Licensing Manager, and I'll be talking specifically about Section 13.3, Emergency Planning.

Next slide, please. Ultimately, we do plan to have one single emergency plan for all four

Turkey Points nuclear units. As you can see on the slide, the transition plan is basically built into our E plan, and in the annexes. The plan is formatted in accordance with NUREG 654 and provides detailed information regarding each of the 16 planning standards and association and evaluation criteria.

Part 1 of the plan provides introductory information. Part 2 provides generic information applicable to any of the units, and then the three annexes describe unit-specific information. You realize since we do have existing units there, we have over 20 plus years of experience with the offsite organizations.

They're the same organizations that we interface with as part of 6 and 7, and it made our basically application, as far as E plan goes, much easier I guess as a Greenfield site as the other applicants are. You know, and in addition we had FEMA review the plan.

Specifically on the ETE, the Evacuation Time Estimate, we did want specific to Turkey Point 6 and 7, and it did project the population out in outer years with growth. So that was accounted for -- that population growth that you saw in Chapter 2

was accounted for in our Evacuation Time Estimate.

Okay, next slide. All right. Just to recap, the Turkey Point site is located approximately 25 miles south of the City of Miami. The EOF, the Emergency Operations Facility, is the same facility used for Turkey Points 3 and 4, is 26 miles from the site.

On the east side of the plant Biscayne Bay, Biscayne National Park. Again the west, too close to cities Homestead and Florida City, and just west of those is of course the Everglades National Park. The closest primary public roads are U.S. Highway 1 and the Turnpike.

We have two site-specific departures for the emergency plan, which are associated with the location of both the Operations Support Center and the Technical Support Center. So go to Slide 72. Okay. Turkey Point Units 6 and 7 will have a common OSC, which is evaluated in PTN Departure 18.8-1.

The OSC is located in the maintenance shop/office building located inside the protected area, and it's shown on the figure here. The use of the common OSC is consistent with existing emergency plans for both Port St. Lucie, which is a two unit nuclear site north of the Turkey Point site, and the

existing of course Units 3 and 4.

Again, ours will be located in a maintenance support building inside their protected area. Both St. Lucie and Turkey Points 3 and 4 have a maintenance support building basically where the OSC is located.

Next slide. The alternate location of the OSC meets applicable requirements, and relocating the OSC does not adversely affect its function. Therefore, this departure has no safety significance. So any questions, we can go onto the next slide.

MEMBER SKILLMAN: Yeah. I would just ask when you really have a weather event coming in, particularly from the east, what is the protection for your workers to get up there?

MR. FRANZONE: Usually if we know we have say like a hurricane coming, we always pre-stage all the workers and all the people we need for the first end, depending on the storm. You have one, two or three shifts that you would have available. So like particularly after Hurricane Andrew, people were able to make it to the site, but then actually the first few hours some people were able to make it.

I myself was there within about 20-30 hours I was there. So yeah. So usually -- well, for any of the storms that I've been through down there, we always pre-stage personnel at the site, so we didn't have that issue really. Because you know, in a bad storm, as we saw in Hurricane Andrew, the actually white poles blocked the roads. It was difficult to get down there, but you could still get through so --

MEMBER SKILLMAN: Isn't the other feature you know that that is coming.

MR. FRANZONE: Correct.

MEMBER SKILLMAN: So I mean as you begin to see that weather system forming and you know what the pressure is, and you've got advance warning. In fact, your tech specs probably push you into plan ops that direct you to do certain things?

MR. FRANZONE: We've committed part of the existing emergency plan with this emergency plan. We intend on shutting down the units prior to the arrival of the hurricane. Depending on what category, we'll either reach a cold shutdown state or stay at hot standby, depending on what category.

MEMBER SKILLMAN: Thank you, Steve.

MR. FRANZONE: Okay. All right, next

we'll discuss PTN Departure 18.8-2, which evaluates the relocation of the Technical Support Center. The Technical Support Center would be located in the new Turkey Point Training Building. This location provides the ability to either -- the ability to respond to either facility in a timely fashion, independent of which unit may be affected by the emergency. Next slide.

MEMBER STETKAR: It's a little different. The Technical Support Center is outside the gate. The Operations Support Center is inside. Huh.

MR. FRANZONE: Well, it is similar the V.C. Summer that was just approved a couple of years ago. So in its other, I don't know.

MEMBER BLEY: That's right.

MR. FRANZONE: Yeah, so okay.

MEMBER SKILLMAN: Is it going to be one TSC for all four units or one for each?

MR. FRANZONE: Correct.

MEMBER SKILLMAN: One for all four?

MR. FRANZONE: One for all four units.

MEMBER SKILLMAN: Okay.

MEMBER STETKAR: And where does that TSC get power from?

MR. FRANZONE: That's really detailed design that we haven't really got to, but we do have, plan on --

MEMBER STETKAR: It might be important to the people who have to go there.

MR. MAHER: This is Bill Maher, Florida Power. Plans are for this TSC to be within a hardened facility. So it will have -- a storm-hardened facility, not necessarily a nuclear hardened. But it will have separate power supplies, diesels and --

MEMBER SKILLMAN: Okay, thank you.

MR. FRANZONE: Okay. It's Slide 75, correct, yeah. So as discussed on this slide, you can see we do meet most of the guidance of NUREG-0696 Functional Criteria for Emergency Response Facility. However, it does not meet this guidance in several areas.

Next slide, Slide 76. Okay. Of course the location is outside the protected areas in Units 6 and 7. The separation of the Technical Support Center from the control room is approximately 2,500 feet with a travel time of 15 minutes, which does include processing through the protected area security control points.

Although the TSC does not provide for face to face communication or being within two minutes of the affected control room, it is provided with dedicated communication links which can transmit, receive voice and data transmissions from the control room, from the OSC and the EOF.

Therefore, the location of the TSC meets applicable requirements, and relocating the TSC does not adversely affect its function. Again like I said, in addition this is similar. It's the same arrangement that was approved for V.C. Summer Units 2 and 3 combined license. That concludes the presentation unless anyone has questions.

CHAIRMAN RAY: Questions? Before you ask Dana, let me say staff has advised me during the break that they will be able to discuss the offsite planning, circumstances in some more detail if we have questions about that. Go ahead.

MEMBER POWERS: The only downside you identified in this was that there is not the opportunity for what you call face to face communication, and that you're compensated for that with various forms of electronic communication. I certainly don't know, but is that -- how big of a downside is that?

MR. FRANZONE: The existing units have a TSC that although not located outside the protected area, it's located pretty far away from the units, and --

MEMBER POWERS: It doesn't matter right?

(Simultaneous speaking.)

MR. FRANZONE: Yeah, we don't really have any issues.

MEMBER POWERS: My question's still the same. How big of a downside is that?

MR. FRANZONE: Just from my personal experience, it really wasn't any downside to it.

MEMBER POWERS: The question is, when we have had emergencies at various kinds of facilities, what is the experiential base on not having face to face communications versus having face to face communications? Do we know anything about that? I mean I don't.

MR. MAHER: This is Bill Maher, Florida Power. About the only -- while there may not be face to face communications, we have ingrained as part of our communications structure within the nuclear facility itself, three-way communication. So we're very similar to that, to what is already in military and --

MEMBER POWERS: Well I mean everybody uses three-way communications for these things. The question is when you're dealing with fairly imponderable things that are outside norm of experience and you're relying on expertise.

I rely on John's expertise which he is a fount, do I get the same information flow from them via this electronic thing as I do face to face? I don't know the answer. I'm just posing the question.

MEMBER STETKAR: Let me ask a technical question, because I get mixed up on all of the different designs that we look at, and I haven't thought about AP1000 in quite a while. Most of the designs, the information flow to the Technical Support Center is from non-safety-related DC power, for example.

So it's going to go away. I mean people in the Technical Support Center will be blind and deaf. It's nice to have people that you can talk to face to face in close proximity to you, said Technical Support Center people become blind and deaf. So that's part of my question about where is the Technical Support Center going to get its power from, and where is the signal, all of this wonderful

communications and data transfer being powered from inside the fence because it's going to go dark, because it's not required to be available.

One of the reasons why the Technical Support Center is usually in reasonable proximity to the main control room. So have you thought about that, and I don't care what anybody else has done.

MEMBER SKILLMAN: I would weigh into this as follows. I spent a lot of time on this at a live unit and in a broken unit, and both in the EOF and the TSC, as offsite director and also as a TSC coordinator, having face to face with the shift supervisor was extremely valuable, because an awful lot that gets communicated is not fully with words.

It's with body language, it's with a nod, it's with pointing to a procedure, things you can't see over the monitors. The other thing is the feed into the EOF and to the Tech Support Center is normally is SPDS, Safety Parameter Display System. So like John says, as long as that information is passing, you have a common denominator between the control room, the EOF and the TSC.

If that link is broken, like he says, the TSC and the EOF are blind. So that face to face with TSC is valuable. I was not party to the prior

action that allowed the TSC to be a distance. I would suggest that people support what they help create. You can make it work if you work hard enough at it.

But there certainly is an element of convenience when the Tech Support Center coordinator and the shift supervisor or the shift manager can see each other, because the TSC really becomes part of the technical conscience of where the plant is going. So I'd just say that much, having lived that life.

MEMBER BLEY: Well but you know, living that life in one sense, but in the other sense we haven't had a case since we built the first TSCs after Three Mile Island event, where we have in any way reached giving control from one to the other.

The SROs aren't going to leave the control room, even if the place is next door, to go talk to the Tech Support Center. So the face to face we have is by sending a runner over to go talk.

MEMBER SKILLMAN: Or the TSC coordinator goes to the control room.

MEMBER BLEY: Oh he does, but if we now have this situation where control is shifted to the TSC and they're implementing the SAMGs from over

there, that might get awkward as well. So I'm not sure. I mean it's a question to think about an awful lot before we get caught in this situation.

There's experience in military places where you have this kind of control, and it's proved to work pretty well. But you have to exercise it, and I don't know that anybody is -- how well people are exercising it now.

That's the key thing. John's point is really key though. If somehow you lose the communications or you lose indications over in the TSC, the whole plan doesn't work right anymore.

MALE PARTICIPANT: I agree.

CHAIRMAN RAY: Yeah. Well, I guess without opining on the subject and like others of you have been in the TSC numerous times during drills, thankfully never during an event, but I guess I would say we did -- I'm sitting here trying to remember this discussion from years back, when we had a prior, as they said, Summer as an example, where this has been the case.

I don't want to try to dredge up recollection of that, and say here's what went on in that discussion. I just know a discussion did occur, and if we have a concern about it, as well we

may, whether it's electrical or physical or whatever, I think perhaps we need to pursue it other than -- well, when you get whatever information applicant in this case wants and can provide this.

But it does have other implications. In other words, we only passed this earlier, had a discussion about it, which I can't try and recap here. But there were issues such as the problem that can be created when the TSC personnel are -- have too much access to the control room, for example.

So I'll just end it there and say I don't want to say this isn't something that ought not to be pursued, but if so we need to keep in mind that it's something that's going to affect other things.

MR. MAHER: This is Bill Maher Florida Power. We have George Madden on the line. He's on the private line and he was the engineer in charge for development of the security plan, or I'm sorry, of the emergency plan aspects for our ETE and coordinating with the agencies, and he -- I think George if you're on the line, your line is open now

MR. MADDEN: Yes, I am. George Madden from Florida Power and Light.

CHAIRMAN RAY: Please go ahead.

MR. MADDEN: All right, the separate TSC. At the Florida Power and Light Unit, St. Lucie 1 and 2. It's a two unit site, two control rooms, one common TSC for both units. It happens to be located inside the Unit 1 auxiliary building, but they are separate, completely separate structures going back and forth.

Turkey Point 3 and 4, again a two unit site but it's a little different. It's for the single unit site. It has a common control room and a common aux building and one side of the hall is the Unit 3 and the other side of the hall is Unit 4. They have a common TSC for both units. It's located inside the PA, but it is located in a separate building, where the ventilation is controlled.

Turkey Point St. Lucie has a common Operations Support Center. It's located in the maintenance support building, similar to what we're doing here, and the thing is you have a lot of your equipment and a lot of your people are there, and they can then go to either site, either unit and support either unit more easily than if you had a single OSC in one of the two AP1000s.

I think to remember with the AP1000 that

when it was designed, it was designed as a single unit on a single site.

CHAIRMAN RAY: That's correct.

MR. MADDEN: So you only have one -- you only had one TSC and one OSC because you only had one unit you had to support. Our common TSC outside the protected area, similar to V.C. Summer is from the advantage of if you have a security event on the site, you'll be able to staff that area more easily than you can getting people in and having them move around inside the site during a security event. So that's an advantage of it.

The other advantage of it is on a larger event that may involve more than one unit, you have the more people located there and you can coordinate for the sites. We have two separate protected area on the Turkey Point 3 and 4, one protected area. Turkey Point 6 and 7 and another protected area.

So it allows us to coordinate and deal much better when it's in a single location and your management is in a single location and they get a larger view of what's going on on the site.

CHAIRMAN RAY: George --

MR. MADDEN: So that's some of the advantage of that --

CHAIRMAN RAY: George, George? Can you answer the question about the reliability of the indication in the TSC and relative to power and whether the other connections are required?

MR. MADDEN: I can say I've been through storms at the sites and we haven't had a problem if they're located separate from the building, and we haven't lost them. The Turkey Point, the common PSC that we're going to have is going to have the ventilation protection similar to the control room.

We are going to have a separate generator to power inside that building in the Training Center. So it is powered up and the only thing that would stop your communication is something that totally disrupts the ground and takes your lines out for communication. We do use closed circuit TV between the control rooms and the TSC at Florida Power and Light. So there's many things we use, and it also goes out to the EOF.

CHAIRMAN RAY: So you have a standby diesel generator that can power the facility?

MR. MADDEN: That's right. That's part of the plan for that part of that structure.

CHAIRMAN RAY: Okay. Other comments, questions to George or to the applicant?

MEMBER BLEY: Well, two brief ones from me. The first one is will the instrumentation panels in the TSC that are getting feed from the four units be at the same level of cyberprotection as of the units themselves?

MR. FRANZONE: Yes.

MR. MADDEN: Yes.

MR. FRANZONE: Yes.

MEMBER BLEY: That's really a yes?

MR. MADDEN: Yes.

MEMBER BLEY: I'm really glad to hear that. The second is can you tell us a little bit about how much involvement you have of licensed senior reactor operators and however qualified they are, the emergency directors who would take over operations in the TSC? How much involvement of those two kinds of people are there in the design of this new TSC?

MR. MADDEN: We dealt with the existing emergency planning and operations personnel, you know, emergency planning personnel for Turkey Point 3 and 4, and the corporate emergency planning manager, who has overall the familiarity with all of the next era and the Florida Power and Light units, so that we interacted with them and they were

involved with all of our meetings with the state and local management authorities, and in what we're doing for the building.

Certainly as we get closer to actually designing the final, we have description of the building right now and requirements that are going to be on the building. But we get into the detailed design, the operating people from the operating plant will be involved in those kind of discussions.

MEMBER BLEY: Okay. I could read that several different ways. When we've dealt with them, sometimes we deal with them by saying here's what it looks like, is that okay, and that -- there isn't much they can do about it, and the other is to have them involved in decision-making as you develop the --

MR. FRANZONE: Right. They were -- this is Steve Franzone. They were in develop in the very beginning. We contacted them directly when we started the COL application, and it wasn't just in E plan. In other areas that we had some -- they had some nexus with the 6 and 7. E plan was probably the most important, because ultimately E plan was going to be for the site, not just for 6 and 7, and so we wanted their input.

MR. MAHER: This is Bill Maher. Just remember the timing for how we put together the COL. At the time that we were starting the COLs, end of 2007 thereabouts, and at the time we were running construction planning somewhat concurrent with COL. So very similar to what you've seen in Vogtle. We're going to be doing construction, any of the non-safety-related construction prior to COL.

Since 2000 and since whatever, 2008 or thereabouts, that has changed. But the point of saying that is at the very beginning, when we were planning, as Steve said, planning to start with construction, very similar to when COL somewhat concurrently, we took -- we were proactive in bringing security on board for how we were going to do security, bringing emergency planning on board.

So how we were going to move the TSC, what sort of instrumentation would we look at. We brought in all the corporate features for each one of those areas, so that at least we had some idea and we incorporated some of that at least into the COL, what we needed to.

MR. MADDEN: I was involved for 25 years with Florida Power and Light's emergency planning and security organization in licensing, both in

corporate and at the sites.

So I've dealt with all of those people at the sites and in the corporate headquarters. So our original plan is actually to have a common TSC was proposed by the operating fleet organization for the TSC for Turkey Points 3, 4, 6 and 7.

Another site that's similar to this you could look at the Vogtle site. Vogtle's all inside of one PA, but their TSC has been moved to a central building common for all of the units on the site. It's not the TSC that's in the DCD.

CHAIRMAN RAY: Thank you.

MR. FRANZONE: Thank you, George.

CHAIRMAN RAY: Thank you, George. I think we can close the line now. Anything else on this subject? If not, we'll ask Steve to proceed.

MR. MUSICO: I think I can add something. This is Bruce Musico. I'm the senior emergency preparedness specialist in NSIR. I did the review for Vogtle and actually presented before this committee in regard to Vogtle. The issue of the two minute distance between the TSC, the new TSC for Vogtle and the control rooms was fully addressing during that time.

I was challenged quite a bit during my

presentation here with respect to why we found it acceptable. If you look back at the transcript for the Vogtle presentation, you'll see a lot of detail regarding the basis for the acceptability of its location. The common TSC for Vogtle is approximately ten minutes' walking distance away from the control room. In this case, I think we have 10 to 15 minutes.

In addition, in preparation for the Commission to hear and then issue the COL for Vogtle, we had prehearing questions which also, as I recall, included a question regrading the two minute walking distance, and it was again fully discussed in the response to their question.

So if you look at the record for Vogtle, you'll see a full answer regarding the flexibility that we now allow for that two minute walking distance, which accounts -- which takes into consideration the advanced communication and advanced data capabilities that exist now.

Because the two minute walking distance was originally proposed, originally in NUREG-0696. That was 1981, and we looked at the progress that the technology has had since that time, and it became evident and clear to us that these advanced

communication and data capabilities were sufficient to account for that two minute walking distance.

MEMBER POWERS: I knew we had --

(Simultaneous speaking.)

MR. FRANZONE: Pardon?

MEMBER POWERS: John tells me I'm blind. Am I still blind?

MEMBER STETKAR: I don't know, because in the certified design, there's only a requirement that you have uninterruptible power supply to drive the TSC displays for two hours. I'm assuming they have to meet that, because it's in the certified design, unless they're taking a departure from that requirement.

After that, at least as far as the certified design this concerned, the TSC becomes dark and you have to rely on some other means of transmitting information from what the operators know to what the folks in the TSC know.

MR. MUSICO: This is Bruce Musico again. I think I can address part of that. With respect to -- I did the review of the AP1000 DCD, so I'm somewhat familiar with that from an emergency planning standpoint.

As I recall, there's a 72 hour time

limit that power, if we look at the power available to the TSC. From an EP standpoint, emergency planning standpoint, we didn't get into the power -- the power sources and the levels that they provide. Another group does the power sources.

Now for the AP1000, the TSC is located in the power block, and it has a common ventilation system with control room. So we would expect to have a higher level of dependability with respect to power supplies.

But for Vogtle, they did propose and are building a separate common TSC for the units, and we found that acceptable from an emergency planning standpoint with respect to the regulations and guidance that apply.

MEMBER STETKAR: I understand what you look at. I understand what everybody looks at in a disjoint manner. I will -- as soon as I pull it up, since I wanted to make sure I had recalled it correctly.

Section 18.8.3.5 of Revision 19 of the AP1000 design certification document says, and I quote, "An uninterruptible power supply system provides approximately two hours of backup power supply to the TSC displays should AC power become

unavailable." That is the certified design. After that time, it gets dark.

MR. FRANZONE: Okay.

CHAIRMAN RAY: Wait a minute, stop. This is not that design, nor is Vogtle, nor is Summer, and so we want to talk in this case about this design, which is a separate facility with its own standpoint power supply.

MEMBER STETKAR: I can power up my big screen TV at home, and if the Dish Network is not supplying signals to me, my screen is blank. I need power to the stuff that's being fed to me so that I can see things on my big screen TV. That's my point.

CHAIRMAN RAY: So the question then not is the EOF dark, but does it have access to the data, which is my -- I thought was the question I was trying to ask before, and the answer was yes, unless there's something physical that has disrupted the communication. I thought that's what the answer was I got. Maybe not.

MR. FRANZONE: That was the answer you received.

CHAIRMAN RAY: Okay.

MEMBER STETKAR: Or the power supply to

whatever's driving the stuff that's sending the signals out to the TSC, because according to the certified design that stuff only needs to be available for two hours.

CHAIRMAN RAY: All right. Let's take a question to be answered separately, whether Member Stetkar's concern, which is that you have the lights on in the TSC. You have the integrity of the cabling to the plant. Is there some other thing that could be interrupted, such that the TSC wouldn't get the information that it needs?

MEMBER STETKAR: The motion is that this is a rare event, and part of the benefit -- I'm fully aware. There are pros and cons of having central TSCs and for a variety of reasons.

Just want to make sure that people have thought about this before you spend a lot of money designing something that people are going to be really annoyed when the bad things happens, because the next thing that happens is going to be bad and we haven't thought about it, and then suddenly everybody's going to want to get into each of the units because they don't have any of the information.

CHAIRMAN RAY: Okay. Unless you're

going to answer it now, please plan to provide the answer at the full Committee meeting. The question is the lights are on and unless we haven't had an interruption of the connectivity, is there something else that would perhaps be associated with the certified design limitation, that would prevent the data from accessible in the TSC, any other thing possible.

But as was said, that's perhaps why I couldn't remember much about it. It wasn't Summer. It was Vogtle where we went through this at great length, because it was the first departure that at least I had been through. Anything else on this topic? Dana, do you have any further thing you want to pursue on it?

MEMBER POWERS: Well, I did want to chat with the staff.

CHAIRMAN RAY: Sure, and it sounds like the staff is ready to chat back, so we'll take a minute and do that when he gets up there.

MEMBER SKILLMAN: Let me just ask one quick question please. Your EOF is 26 miles away. Is there any required traffic between the sites and the EOF for any level of emergency? Is there any required travel between the site and the EOF for any

level of emergency?

MR. FRANZONE: You're talking about time limit?

MEMBER SKILLMAN: Yeah.

MR. FRANZONE: That has to be manned within one hour.

MEMBER SKILLMAN: So does that mean people have to travel from the site to the EOF?

MR. FRANZONE: Not necessarily. It's from wherever they're located to the EOF, and it's the existing unit and we've been very successful. So it's not, hasn't really been an issue.

MEMBER SKILLMAN: Okay, thank you. Thank you, Harold.

CHAIRMAN RAY: Sure. Okay. Let's -- are we done? We're going to get into another completely different area here now I think, is that right?

MR. FRANZONE: Correct. Chapter 19, Probabilistic Risk Assessment.

CHAIRMAN RAY: All right. I'll step back and be quiet because that's not anything I can contribute to. Go ahead.

MR. FRANZONE: Okay. We incorporate the AP1000 DCD by reference with standard material with

a couple of exceptions. These exceptions are in two areas, the annual frequency of severe winds and tornado events exceeds 1E to the minus 7 events per year, and the annual frequency of aviation accidents exceed 1E to the minus 7 per year.

Section 19.58 which is titled "Winds, Floods and Other External Events" addresses these two site-specific issues. Two screening criterias are used to determine whether detailed PRA is required.

Next slide. Okay. First, the external event category can be screened out on the basis of the annual frequency between less than 1E to the minus 7 per year. If the parameters this criteria, no further evaluation is required. However, if not met, the second criteria is used to determine if a detailed PRA is required.

External event categories can be screened out based on the annual core damage frequency (CDF) associated with that particular external event category. More specifically, the core damage frequency, if it does not exceed 1E to the minus 7 events per year, the event external -- external event category can be screened out, okay.

As presented in Section 2.2, the annual

frequency of aviation accidents exceeds 1E to the minus 7 events per year. A base case screening CDF was performed as well as the additional sensitivity cases, to account for a distinction between small and large aircraft crashes and the base case results of 2.26E to the minus 13 events per year is well below the screening criteria, and a detailed PRA was not required.

We'll address PT and departure 19.58-1 next. SR Table 19.58-201 shows that the initiating event frequencies for high winds at Units 6 and 7 are higher than those in the DCD. Therefore, a site-specific analysis of high winds and tornadoes was conducted to determine the CDF.

Three case studies were performed. Case 2 is considered the base case, which represents a conservative model for high winds and resulted in a CDF of 1E to the negative 8 events per year, and therefore a detailed PRA is not required. Any questions there?

MEMBER STETKAR: Yes. For the aircraft crash, the conditional core damage probability from your analysis is 5.85E to the minus 8 for the aircraft crash. So I -- that's a really teeny tiny number. So I decided to go see well, what's the

source of that, and apparently you ran a loss of offsite power with failure of standby non-safety systems.

Well I don't know. I haven't seen the PRA and you can't see the PRA, but apparently something got run through there that came out with a teeny tiny number. So I went back to the DCD PRA, which we can't see because that's not documented in there either. But I did notice that there is one initiating event that's called spurious actuation of ADS, that has a conditional core damage probability of about 5.5 times 10 to the minus 4, about a factor of 10,000 higher.

Then I start thinking about well, if I have an aircraft crash inside the plant, the discussion in the FSAR for Turkey Point refers back to Appendix 19F Frank of the DCD, and I don't want to get into too much details because we're talking about the stuff that borders on security-related stuff.

In 19F of the DCD, they focus exclusively on large commercial aircraft impacts into the containment and draw the conclusion that those impacts do not damage any safety-related equipment inside the containment. It's not clear to

me how that conclusion relates to modeling a loss of offsite power with no non-safety systems in my PRA.

So I'm asking you how did your conditional core damage probability of 5.85E to the minus 8 account for things like spurious signals that could be caused by an aircraft crash and a fire, outside of the containment now, and places that are -- I don't want to talk about specific locations. But spurious signals, like a spurious signal that might cause a spurious ADS actuation, that has a conditional core damage probability of 10,000 times higher than what you used? So what did you model? Did you model just a clean turnoff of AC power?

MR. FRANZONE: Mary Richmond from Bechtel. She'll respond.

MS. RICHMOND: Hi. This is Mary Richmond from Bechtel. It's actually Westinghouse that did the modeling and chose the loss of offsite power as its -- as what would be done.

MEMBER STETKAR: Well, that's pretty much the most benign thing for this design that I could think of. So I'm not arguing with the notion that maybe the total core damage frequency might be less than 10 to the minus 8th. I'm arguing with

what the heck did you do, because it's certainly not documented anywhere.

If the only thing that you did is take out off site power, that is -- I'll use the word very questionable as far as a reasonable assessment of what might happen if a military fighter plane, an F-16, which is one of the elements of your aircraft crash, crashes into that plant.

MR. FRANZONE: Zach, can you respond or --

MR. HARPER: This is Zach Harper at Westinghouse. I'm not, I don't have the answer to your question so we'll have to take that --

MEMBER STETKAR: Okay. It's on the record.

MR. FRANZONE: Do you understand the question?

MR. HARPER: Yes.

MR. FRANZONE: Okay.

MR. MAHER: So this is Bill Maher from Florida Power. We'll get back to you on that as part of the full Committee.

MEMBER STETKAR: Yeah, I appreciate that. Again, I'm not necessarily challenging the high level conclusion. The conditional core damage

probability would have to get above about 2 or 3 times 10 to the minus 3. I mean I don't want to quibble over numbers is the thing. You've got three significant figures on a teeny tiny number.

The discussion I had this morning is I think the crash frequency is probably middlish times 10 to the minus 6 event per year.

MR. FRANZONE: Right.

MEMBER STETKAR: So to get less than 10 to the minus 8th per year you need something that's less than a couplish times 10 to the minus 3, and you probably, probably can justify that. But I'd really like to see what you did, and make sure that there aren't any things sneaking out there that might be higher than that couplish times 10 to the minus 3.

CHAIRMAN RAY: Okay. At the full Committee, we will need to give an overview. But we will also try and work in specifics like I think this is the second one that we want to cover at that time.

MEMBER STETKAR: We probably can't get real, real detailed obviously because it's layout of the interior of the plant and fire analysis and, you know, impact locations and stuff. But if I could at

least better understand what sort of what you consider to be a bounding scenario that use the basic characteristics of it.

MEMBER STETKAR: We'll characterize how we developed that for you.

MR. MAHER: All right, and this is Bill Maher again. To the extent that we can keep it outside of closed or proprietary stuff.

MEMBER STETKAR: That's exactly what I was saying, is all I'm trying to get a notion of is we failed the following things in the following way as a bounding type scenario.

MEMBER BLEY: It's a scenario issue.

MEMBER STETKAR: Right.

MEMBER BLEY: For a plant that doesn't need electric power, taking out electric power doesn't seem like what you should have done.

MEMBER STETKAR: And especially because there's evidence, and this is in the public version of the DCD. There is evidence of at least one type of spurious signal scenario, the spurious ADS actuation that did have a much higher conditional core damage probability, and that was with power available.

CHAIRMAN RAY: Okay, all right.

MR. FRANZONE: We'll go on to Chapter 20. The next slide. All right. So good afternoon. We'll be discussing requirements resulting from the Fukushima Near Term Task Force recommendation. There's basically three areas which we'll discuss very briefly, the emergency planning, the mitigating strategies and then the spent fuel instrumentation.

Really, there's no different than from what you saw from other licensees and applicants. No. Go back, yeah. We work with other Westinghouse, with other applicants and licensees and Westinghouse, you know, basically through the Design Center Working Group and APOG to basically follow the industry standard or the AP1000 standard I should say.

We'll just briefly go over each of these recommendations that have really turned into license conditions for us, and they're the same license conditions we expect to receive, that Levy will receive and Levy will receive so --

First item. Okay. So emergency planning there. Our license condition, our proposed license condition reads exactly the same. Let me see. Unless somebody has a specific question on each of these areas that we can address, I really

wasn't going to go over the details of each one. Okay.

CHAIRMAN RAY: That's fine.

MR. FRANZONE: Yeah, next slide. Mitigation strategies. You know, develop and implement guidance and strategies to maintain or restore the core cooling containment spent fuel. That reads the same as the other applicants. Okay next.

CHAIRMAN RAY: With the FLEX be, at least some of it be available to the other two units as well, the operating units, or is there a separate facility, completely separate --

MR. FRANZONE: Well, we work through APOG and the same FLEX document that they have we have, and actually we put it on our docket already, just for the staff's benefit. So there's no difference. I imagine by the time we actually come to this point, there will probably be changes that we'll have to address, you know.

CHAIRMAN RAY: Okay. But you're not planning on a separate warehouse of stuff as compared with Units 3 and 4, yeah.

MR. FRANZONE: Okay, next. Spent fuel instrumentation. There is no difference there.

Same departure. Just if you're familiar with this, we found, corrected an inconsistency in one of the DCD tables, and we took that same departure. That's really all I was going to say on the Fukushima, unless anybody has any questions. Okay.

CHAIRMAN RAY: No, go ahead.

MR. FRANZONE: Next slide. Okay. So again, just as you saw in the Levy ACRS, the ISG-11 reviews, we have the same five issues which consist of five exemptions, six departures. Our submittals were technically identical to the Levy submittals, and were formatted similar to the Levy submittals.

Basically it was a single submittal versus multiple submittals that the Levy had to make. FPL participated in the review of these issues as part of the Design Center Working Group review effort led by Duke. So I do have a slide on each of these, and so what I'm planning to do is basically go through each slide and see if you all have questions on issue. Or if you want, I can review the issues. So --

CHAIRMAN RAY: Whatever's the most expeditious. If any of the members wish any one of these, which we've of course have gone through not long ago, particular attention to them. If not,

handle it any way you wish.

MR. FRANZONE: Yeah. Then we can go through each one and I'll just, so you can see the slides anyway.

CHAIRMAN RAY: All right, yes.

MR. FRANZONE: Condensate return. Next slide. Here's the control room dose, fairly straightforward. Hydrogen venting. Air FLEX doubling and then the last is the main control room.

CHAIRMAN RAY: Too familiar I'm afraid.

MR. FRANZONE: Right, yeah. We actually used -- next slide. We just took the slides that Levy had actually used in the full Committee and modified them slightly. All right, and then that concludes our presentation.

CHAIRMAN RAY: All right. You all will stand by, I trust, as the staff completes their presentation for any final questions that we might derive?

MR. FRANZONE: Yes sir, thank you.

CHAIRMAN RAY: Okay. Manny?

(Pause.)

CHAIRMAN RAY: Now do we want to deal with the, I'll call it the carryover item first, or you looking to me like you're going to --

MR. COMAR: Whatever needs time. It's almost like simple slides like --

PARTICIPANT: Microphone.

MR. COMAR: My presentation is similar to what the applicant had.

CHAIRMAN RAY: All right then --

MR. COMAR: So if you want, we can go or we can go through --

CHAIRMAN RAY: You're prepared. Go straight ahead and then we'll get back to emergency planning stuff.

(Pause.)

CHAIRMAN RAY: Good thing I have my own good pointer after the end of it.

MR. COMAR: Good afternoon again. I'm Manny Comar. I'm the lead project manager for Turkey Point. So I'll go through the similar topics that the applicant went through, and we'll start with 13.3 the emergency planning on which we had a discussion.

Next slide, please. It's been identified looking at 26 miles from Turkey Point, and it's using the same unit, same thing what 3 and 4 has been using. While the location of existing (indiscernible) was outside the scope of the COL

application review, the capabilities to support (indiscernible) against the applicable guidance and (indiscernible).

We have just had a lot of discussion on TSC and OSC and I'm not going to get more in detail about it. It meets the requirements of the NUREG-0696 and the numerous ITAAC that has been identified to see that it operates properly.

CHAIRMAN RAY: Okay. Now Dana, isn't this the point at which you would like to pursue and --

MEMBER POWERS: Well, I mean what's been said is that it meets your criteria. But the applicant indicated that the downside was the ability to have face to face communication between the TSC and the Operations, and so my question really is how big of a downside is that, and how do we know?

We've got a lot of plausibility arguments, but my question is what is it that we actually know as opposed to what is part of our religious convictions?

MR. MUSICO: With respect to?

MEMBER POWERS: How big of a downside is the inability to have face to face communications?

MR. MUSICO: This is Bruce Musico again. It's hard to quantify the downside from an objective standpoint, except to say that the staff did look at the level of sophistication that existed in the communication and the data systems that are available. Am I on?

Oh, I'm sorry, this is Bruce Musico. The staff did look in detail with respect to the available communication and data systems that are available to communicate between the control room and the TSC and the EOF. They were numerous. There's duplication with respect to the capabilities, and we had previously considered the original intent of the two minute walking distance.

Specifically, I was the reviewer for the Vogtle site and I went back and looked at NUREG-0696, which provides that criteria for the two minute walking distance. As I recall, it was -- it was merely to the face to face aspect of communication was to facilitate the communication and a transfer of data, those two aspects of the interaction between the TSC and the control room.

And in 1981, and I worked at the plants at that time, there were limited communications capabilities. For example, one of the most

sophisticated -- one of the more sophisticated pieces of equipment that were available at that time was a fax machine, and usually I was one of the engineers at the time and we didn't know how to operate it. We had to get a secretary to help us.

But the advancements in the communications system, in cell phones now for example, as well as the data systems that are now available, we found those adequate to compensate for a slightly longer walking distance between the two facilities. Where it seemed that the communication and the data systems were so numerous that you did not absolutely have to have that face to face communication.

However, the face to face communication is still available, because the TSC still was on site and it's not that far away. It's 10 to 15 minutes away as I recall for the Turkey Point site. So we found that to be adequate. I'm not sure if that answers your question or not, Dr. Powers.

MEMBER POWERS: Well, yeah. I don't doubt that you found it adequate. I just don't understand how you came to the conclusion.

MR. MUSICO: It was a judgment call with respect to the original intent behind --

MEMBER POWERS: See that's why I have -- I understand it.

MR. MUSICO: And the extent to which that intent was satisfied by the advance communication and data systems that are now available some 30 plus years later. So it was a judgment call.

MEMBER POWERS: My problem is I have confronted with that issue, I have no basis for having a judgment on it. So I'm desperately searching for what was the basis for you drawing that judgment.

I mean do people in emergency situations seeking advice function as well or adequately well with remote communication versus face to face communication?

MR. MUSICO: I think you need to look at the history behind the original requirement for the two minute walking distance. As you may recall or not, it was originally a product of the response to the Three Mile Island accident, in which there was no TSC at that time, and there was confusion with respect to too many people in the control room.

MEMBER POWERS: That's right.

MR. MUSICO: And they wanted to have

that separate facility, and that was one of the issues that came up which was addressed in the guidance, which introduced the two minute walking distance.

MEMBER POWERS: What nags me a little bit in the back of my mind is yeah, I'm familiar with that direction. But we've now had another accident in which walking two miles or two minutes across the site was hazardous to your health, because we had a substantial amount of radioactivity circulating around the walkway pathway, walking pathway, okay.

That constitutes a barrier to consider. But I think fundamentally my question is more on how degraded is communication when it's via electronics rather than face to face?

MR. MUSICO: How degraded?

MEMBER POWERS: Yeah.

MR. MUSICO: The ability to communicate?

MEMBER POWERS: Uh-huh, in an emergency situation where I'm pondering things, or which the guidance is going to be a set of judgments, because nobody's been in this situation before and nobody's going to be able to tell you if you push this button, then all will be right with the world,

guaranteed, because I'm an expert and I know about these things.

Yeah. You're going to say well, it looks like the best option is to try thus and so and see if that will work. I mean it's the kind of judgment or information you're going to get.

CHAIRMAN RAY: Can I make a comment here and hope that it will be helpful. We do drill and perform exercises that include the TSC regularly.

MR. MUSICO: Yes.

CHAIRMAN RAY: And the question then could be what have we derived learning from that experience relative to the advantages or disadvantages of a separate TSC? I was in a plant with two TSCs for separate units, and one was quite old, one was not quite so old. But the fact that we had a window looking into the control room never was of any benefit, and we never wanted to go in the control room because we would interfere with the activities that the operators were performing.

Everybody in that TSC was occupied with their tasks, and didn't function as an advisor to the control room staff. Now you've been in this a lot more than any of the rest of us, but I mean that's the sort of thing I think Dana's asking about

is in the experience that we have, what did we find out about the needed interaction between the TSC and the control room, because my goodness we --

Actually we do it in a simulator now, but you do these exercises a couple of times a year, where the TSC is activated and interacts with the control room staff, and they don't have direct access typically to those exercises.

MR. MUSICO: Well that's a good point, that the plants are exercised regularly with respect to utilization of these systems, the data and the communications systems. The standard that -- the conclusion that we come up with, the standard is finding a reasonable assurance, not absolute assurance.

And with respect to the capabilities that are now available, the advanced capabilities, the multiple duplication of capabilities that are available for both communication and data systems, as exercised during periodic drills and exercises, we found that that was reasonable with respect to the original intent of the two minute face to face time, as far as just communicating --

Communicating with the control room operators and acquiring data from them directly. We

found that to be reasonable. Now as I mentioned earlier, for the Vogtle application, I was sitting here as well and answering the same question, and then later answering the Commission's question regarding that issue.

I can certainly provide you the detailed answer that we provided the Commission with respect to the various factors, why we thought it reasonable if you like.

MEMBER POWERS: Well, I mean that sounds interesting. I think probably my answer comes by approaching our Human Factors/Human Performance people and asking them what they know on this subject regarding you've already told me this meets your criteria that you've established for licensees. That what he's obligated to do, is to meet your criteria and you're saying it's reasonable and you've pondered it and think it's okay.

I think Harold's hit upon the data source that may not be being mined adequately because they -- perhaps the research staff is not aware that this would be an issue.

MR. MUSICO: What data source?

MEMBER POWERS: This exercising the TSC on the simulators in exercises on a regular basis.

CHAIRMAN RAY: Yeah. In other words, to get the data that I think Dana would be looking for, you would specifically observe drills and exercises, first of all make sure that they were comprehensive enough to give you the results you're looking for and ask the question how often does the people in the TSC have to interface with the people in the control room?

Do they go in and give them advice? Do they need to go get information from the control room, stuff like that?

MR. MUSICO: I don't know what the answer to that question is.

MEMBER POWERS: Yeah. I take your word.

MR. MUSICO: I can add, excuse me, I can add that there are numerous ITAAC, emergency planning ITAAC that are associated with the full participation exercise that address this issue directly with respect to data transmission availability, communications, and the effectiveness of actions taken as a result. So they'll have to exercise that as well.

MEMBER POWERS: Yeah, but I don't think they deal with the qualitative aspect of it, how good --

MR. MUSICO: Well you know, the availability can be distinguished from the quality. When we say "quality," that seems to be a little subjective. But I understand your concern.

But what we look at is the availability of the information, the communication capability, and the extent to which it supports people in the TSC to make the appropriate decisions to counsel the control room operators on actions.

CHAIRMAN RAY: So can we agree that we ought to seek this information through a different path?

MEMBER POWERS: I think that's the right choice.

CHAIRMAN RAY: All right. Then let's go on, but we will want to explore further again, because we have the opportunity to do so, the issue of the population exceedance versus weather, whether there's any connection between that and emergency planning issues.

MR. COMAR: Do you want us to provide --

CHAIRMAN RAY: We'll do that when we -- whenever you say it's time to do it, Manny.

MR. COMAR: No. I'm saying do you want us to provide any of the additional information to

everybody that Bruce was talking about that he presented to the --

CHAIRMAN RAY: I think we need to decide if you're talking about the question of the TSC being remote, not right now, no.

MR. COMAR: Okay.

MR. MUSICO: Let me just add too --

CHAIRMAN RAY: It's just not appropriate to have it on this docket, and if we need something more, we'll get it elsewhere.

MR. MUSICO: There's an additional precedent with respect to the Clinton station. They too have a remote TSC.

CHAIRMAN RAY: I'm sure that's right. But again, we've explored it as much as I think is appropriate here in this context. We'll seek another context, I think, that pushes that further. But we will want to come back, because it's specific to this context, the population exceedance thing versus emergency planning. So go ahead.

MR. COMAR: Let us know when you need it. Okay. Can we go on to the next slide, the next one? As the applicant stated, we explored two areas here for departures from the AP1000 DCD.

One was the hydrogen mixing and

Commission analysis, which basically is common, I think, to all the sites as they're opening in the floor of the core makeup tank compartment, and the current AP1000 design has a different location compared to what is being proposed and we have -- we are controlling that with ITAAC.

The fact that there's a different one, but there is a departure to this effect. We did the analysis to find out the (indiscernible) on AP1000 COLs. But it was not identified to the license that issued to Vogtle and Summer. Following the Design Center review approach, Levy as a reference called for this departure too.

This time we went with extremely low probability, and the staff reviewed the analysis and agreed that a risk perspective is very low on this one. Any further question I can provide you the more detailed calculations.

MEMBER STETKAR: You obviously didn't challenge the applicant about what scenario they used in the PRA for the aircraft crash, did you?

MR. COMAR: No. We ourselves did the frequency of certain external events relevant to Turkey Point. It exceeded the frequency assumed in the DCD, and we -- I have that it says that we did

our own analysis (indiscernible) to core damage frequency, and large release frequency was too small to effect.

MEMBER STETKAR: Oh, you did your own analysis on the condition of core damage probability?

MR. COMAR: I think that's exactly what --

MEMBER STETKAR: You did? Let me -- who did that?

MR. COMAR: I think it's one of our own (indiscernible).

MEMBER STETKAR: Oh. Well how did you -- how did you determine that it was less than 10 to the minus 8th then?

MR. COMAR: Jennifer is not here, but I'll be happy to provide you with the detailed calculations.

MEMBER STETKAR: Okay. Well that's interesting, because I'd be interested -- I know that you did your own confirmatory analysis on the aircraft crash frequency. We discussed some of that a little bit yesterday.

But I'm talking about given the fact that it was greater than 10 to the minus 7 event

per year, how did the staff develop confidence that indeed the core damage frequency then was less than 10 to the minus 8th per year? What I thought I heard you say is you did your own confirmatory analysis.

MR. COMAR: What I'm saying is I need to check with the staff who did this to provide you with the backup information. That's the way I understood it and (indiscernible) in the current calculation to come up with that number.

MEMBER STETKAR: Thanks, thanks.

MR. COMAR: We will provide you with what those backup calculations are. Next slide. These are the four requirements of the Fukushima, which is I think generated to all of them. 2.1 is site-specific so we did that and we've already gone through that. So there is no reevaluation of that one. You went through. Can you go on to the next slide please?

And the applicant and we've already addressed this, the flood and seismic hazard evaluation. So this was one of those recommendations. The next one was our mitigation strategies of beyond design basis external events.

This is in compliance with the

recommendation of the order and with the industry guidance, NEI 12-06 and I think and also follows the license condition that is going to be implemented for the applicant. This is the same with the other ones.

MEMBER STETKAR: Something I just thought about Manny, and I probably should have asked the applicant. Since they can survive 72 hours without any AC powers, does that mean that they essentially have no FLEX Phase 2 equipment? You know, Phase 1 is stuff that's in the plant for some coping duration. Phase 2 is using equipment on site to get through an interim period until you can get help from the offsite.

MR. COMAR: That's right, and Phase 3 is from offsite.

MEMBER STETKAR: The Phase 3 is from offsite, from the whatever they call them, the support centers, the safer centers.

MR. COMAR: Safe location.

MEMBER STETKAR: Does that mean that the strategies for Turkey Point 6 and 7 don't have a Phase 2 capability? In other words, they don't rely on any offsite portable FLEX equipment?

MR. MAHER: This is Bill Maher, Florida

Power. I believe they do have Phase 2 equipment. Generally, it's small pumps for bringing in the pumped water, very similar to the other applicants or licensees. So but we'll be able to get back to you.

MEMBER STETKAR: Thanks. It was just something that, you know, neurons fire randomly.

MR. STUBBS: Okay. This is Angelo Stubbs from the staff, and I think what Mr. Stetkar said was right. Their plant does not credit any Phase 2 equipment portable offsite. In their integrated plan, that was included that we review the phase -- the first 72 hours there's no portable equipment that is credited to be used in mitigation.

MEMBER STETKAR: Thanks Angelo.

MR. COMAR: Next slide, please. This is the same thing we've been proposing, the license condition for the application that is similar to or has been proposed before. 751, it's the same generic applicable to all the AP1000, and this will also have a license condition that is common to all.

And the Recommendation 9.3, Emergency Preparedness (indiscernible) action. This is all simple as the license condition, and I think we can talk about the ITAAC as well as the preparedness

before. We go back to the communication of the accident. I think the event that has been proposed is the extended station blackout that is being reviewed.

Based on that, I think this is the license condition that the applicant is supposed to have in place. The next slide talks about the license condition. It requires 18 months before the latest day, the need to have everything in place and then go through the exercises and then come up with the proposed correction six months before the fuel load. Staff finds this license condition more or less acceptable.

The last one is the Chapter 21, which is the ISG-11 issues. So all we have received from the applicant is a markup proposed for the FSAR, and based on that I think it is a confirmatory item, pending the receipt of the update of the FSAR. That concludes.

CHAIRMAN RAY: Okay. So that's -- your presentation is concluded?

MR. COMAR: It is.

CHAIRMAN RAY: All right. So we're ready now to wrap up, and in doing so, we want to take the opportunity to explore a little further

this question that I mentioned earlier. Again, it can wonder off in different directions. So let me try and frame it as well as I can here.

We have to somehow address ourselves to the population exceedance and where do we rank it, and in doing that, there are two things that are of relevance. One is the regulation itself, which doesn't say anything other than plants should be located in a minimal population area.

More specifically though, the guidance for complying with that has a criterion in it of -- that uses a radial distance of 20 miles and seeks to ensure there's not, within that circular area, that we don't exceed 500 persons per square mile.

There's no connection explicit in the regulation or in the guidance between that and emergency planning. But we're in the category of, excuse me, where we're trying to look at terminology that says a reactor should not be located, this is guidance now again, not regulation, a reactor should not be located on a site where population density is well in excess of this value.

So we're trying to decide well what -- how does one decide what's well in excess? Now I understand, I say again, third time maybe, that it's

not obvious that it's measured by anything to do with emergency planning.

But you're here. People wonder if maybe something is not well in excess, if there's no problem that it creates, whatever the exceedance is with emergency planning.

So we thought we'd take advantage of your being here and ask you to speak to that question. And anything that you can tell us, we understand I think clearly, because it's so -- spelled out in such detail in the ASE, that the emergency plan is okay. There are existing units that have an existing emergency plan at this site.

So we're not questioning the adequacy of emergency planning. What we're trying to figure out is does its acceptability demonstrate that we're not well in excess of 500 people, or that we're not well in excess of the guidance. That's the best I can do.

MR. MUSICO: This is Bruce Musico. With respect to the guidance criteria for siting, that is in fact siting criteria which I believe was applicable for the original siting of the plant.

With respect to how it impacts emergency planning, the impact would be -- would result from

an increase in population, which it sounds like that's what we have here and which is the question. And that is --

CHAIRMAN RAY: Let's call it an exceedance rather than increase.

MR. MUSICO: Okay.

CHAIRMAN RAY: It just exceeds the guideline. That's all it does.

MR. MUSICO: Exceeds the guideline, okay. But from an emergency planning standpoint, it doesn't impact the acceptability of the emergency plan, because the exceedance or the increase in the population is directly accounted for in the updated evacuation time estimate.

In about five years ago, in 2011, the NRC went through some rulemakings, some emergency planning rulemaking in which we updated the requirements in the emergency plans and the emergency regulations to specifically require updating of evacuation time estimates. Prior to that, there was no requirement for licensees to update ETEs as a result of increasing populations around existing nuclear power plants.

There is now a requirement that licensees must update their plans to account, their

ETEs to account for increases in populations. Specifically in 10 C.F.R. 50.47(b)(10), it states in part "Licensees shall update the evacuation time estimate on a periodic basis," and in more detail in Appendix E, Part Roman numeral IV of Appendix E to Part 50, there is -- there are numerous criteria that tell you exactly when the licensees must update the evacuation time estimates, including to reflect the impact of population increases.

So from an emergency planning standpoint, the licensee is required to periodically, annually and from some other criteria. When the census comes out, the new census comes out every ten years, they have to review the data, review the population around the site and if necessary update the evacuation time estimate.

Now from an adequacy of the evacuation time estimate, there is no specific time requirement for an evacuation time estimate that governs the plant. The evacuation time estimate provides a tool, provide information to inform the protective action recommendations that are made by the licensee, and subsequently the protective action decisions that are made by offsite state and local agencies with respect to evacuating the population

as required.

The change in the ETE, it can -- if it increases the time because the population has increased, that would have to be factored into the state and local plans as a consideration, and Appendix C also requires updated ETEs to be reviewed with state and local agencies to ensure that they've accounted for that.

CHAIRMAN RAY: Okay. Well this -- you can go on, but the point I would draw from what you've said so far is there really can be no way of saying that the emergency evacuation, the evacuation time estimate would correlate with the point at which we're well in excess and therefore shouldn't have a plant site. I mean --

MR. MUSICO: Because that criteria was initial siting criteria. What we're face with from an emergency planning standpoint is can they adequately protect the public in the event of an accident.

CHAIRMAN RAY: But we are initially siting these units that we're talking about here.

MR. MUSICO: On an existing site.

CHAIRMAN RAY: Well, but it's the initial siting of these units. It's not a license

renewal or something like that. So in any event, it just doesn't sound like there's any connection that -- I mean if one were to deem an evacuation time estimate unacceptable at some point hypothetically, you could say well, you must --

One reason might be that you're in excess, well in excess of the low density that is called for in the regulations. You could say that, but that would be all you could do.

MR. MUSICO: That density's not applicable to emergency planning, except to the extent that it would impact the evacuation time estimate.

CHAIRMAN RAY: That's what I just said, I tried to say.

MR. MUSICO: I don't know what the answer is with respect to that siting criteria that you're referencing. A question might be, and I hate to pose my own question for you, is that if that is the original siting criteria for the Turkey Point Units 3 and 4, when they were originally sited, to what extent is it applicable to additional units on that existing site? So that might be a reasonable question.

CHAIRMAN RAY: Well, I don't know. The

applicant and staff have both addressed themselves to it responsibly, and we're just trying to do it ourselves.

MR. MUSICO: I understand. Have I answered the question?

CHAIRMAN RAY: As best anyone could, I think. We're going to have to decide whether it needs anything further or if we're done. But that's a discussion we'll have --

MR. MUSICO: Okay. We'll provide anything further if you need it.

CHAIRMAN RAY: Yeah.

MEMBER POWERS: They have not done an ETE for -- like a draft ETE for 6 and 7?

MR. MUSICO: Yes, they have.

MEMBER POWERS: They have?

MR. MUSICO: Yes, they have for the site, in support -- well, the ETE supports the site. It doesn't just support 6 and 7. It supports the entire site and they do an ETE and I believe they updated it to account for the 2010 census, and we reviewed that in detail.

MEMBER POWERS: I don't -- I don't happen to remember the one for Turkey Point, which I would have read just for the existing units so --

MR. MUSICO: The ETE is approximately 413 pages as I recall.

MEMBER POWERS: So they're big documents and they've got lots of stuff in them. But let's -- I mean it didn't take long to find the information you want. In most cases they're kind of cook-bookish documents.

MR. MUSICO: It was updated and well-documented, and we reviewed it in detail.

MEMBER POWERS: Yeah, and I could say that what I find really important is when there are qualitative changes in the population, not the absolutely magnitude. Like you have --

MR. MUSICO: Well, if you mean qualitative, you mean the diversity of the population, the transients, the permanent population, the special needs.

MEMBER POWERS: It's the special needs.

MR. MUSICO: That is all accounted for in the ETE.

MEMBER POWERS: And that's what I said. That's what's useful about them, not so much, you know their -- I mean any one class can double in size.

MR. MUSICO: It's possible.

MEMBER POWERS: And what-not, and that -- it has an effect, but it's not a very big effect.

MR. MUSICO: Well, depending upon the effect, it might necessitate an updating of the ETE, and that's described in Appendix E.

MEMBER POWERS: Yeah, but that's a bureaucratic requirement.

MR. MUSICO: No, I think it's pretty specific.

MEMBER POWERS: You update the number, okay. What's really important is okay now, all of the sudden you have a prison installed on site, in the evacuation area. That makes a big difference to you.

MR. MUSICO: It might, yes.

MEMBER POWERS: Or More likely, I certainly had an elderly care facility set up on the site. Those are big changes. Or a hospital, even worse potentially.

CHAIRMAN RAY: Listen. We're going to agree, I think, that there's no connection between population exceedance and emergency plan?

MR. MUSICO: That's correct, that's correct.

CHAIRMAN RAY: And we're going to

therefore proceed with our business, and we appreciate your input.

MR. MUSICO: Okay, thank you.

CHAIRMAN RAY: We'll have to open the lines so I can talk to the public.

MR. MAHER: I would -- this is Bill Maher, Florida Power. As Steve presented earlier, we do have just the 3 and 4 ETE as part of our submittal for 6 and 7, and then we go through different aspects and phases for during construction, which also includes the ability to remove construction workers, depending on which units are operating.

And then at the very end, it's all four units and the ETE. Just as part of the last comment, there is a prison within the ETE for us.

MEMBER POWERS: Is there?

MR. MAHER: Yes sir.

MEMBER POWERS: I just can't remember. I mean I've been through the Turkey Point ETE, but it's long enough ago that I just don't remember.

CHAIRMAN RAY: Open the line. Yeah. Well, we've got enough of a challenge dealing with population exceedance. I don't want to get into ETE exceedance or changes or anything closely associated

with it. But it's been an interesting topic for us to talk about.

Okay, folks. We're going to open the public line and see if there's anyone who has been listening to this meeting who would like to make a comment to us, and then we'll do similarly with anyone in the audience.

MALE PARTICIPANT: It's open.

CHAIRMAN RAY: All right. If there's anyone on the line, would you please just acknowledge that you can hear us?

FEMALE PARTICIPANT: We can hear you.

CHAIRMAN RAY: Thank you very much, and perhaps you are the same folks who were with us yesterday, and we appreciate your being with us. Is there any comment that you'd like to make?

FEMALE PARTICIPANT: No thank you.

CHAIRMAN RAY: All right, thank you. With that then, we will close the line and I will ask, as I did yesterday, if there's anyone in the audience who wishes to make a comment?

(No response.)

CHAIRMAN RAY: Apparently not. All right. With that then, as is usual for a subcommittee meeting, we'll go around the table.

We are planning and it's on the agenda for the September 4 committee meeting that you've already received, first thing on the first day morning, is we'll come back and have an overview of this application, as well as any specific items that we've put on the list or will put on the list and ask the applicant and staff to address themselves too.

So this is the time at which we can comment on the two day meeting, but also say I'd like to hear more about this event, if anyone wishes to. Ron.

MEMBER BALLINGER: Oh, I thought -- I almost got it. I almost got it.

CHAIRMAN RAY: That's all right. I'm the worse one today.

MEMBER BALLINGER: Pardon me, John. I thought the presentations were very good. They were very much to the point that we were interested in. I just thought it was a good presentation and I have nothing more to say.

CHAIRMAN RAY: Margaret?

MEMBER CHU: I have no comments, but I do want to thank all the presenters. I think I learned a lot. Thank you.

CHAIRMAN RAY: John.

MEMBER STETKAR: Nothing More Harold. Thank you. Again, the same thing, especially the applicant. I thought you covered an awful lot of ground very efficiently.

CHAIRMAN RAY: Dick?

MEMBER SKILLMAN: Thank you to the presenters, the NRC presenters and to the Florida Power and Light team. I would like to hear in the full Committee meeting a brief defense of why injecting liquid rad waste into an aquifer is a preferred method for disposal, as opposed to some other options that are being used in the industry and that are proven today. Thank you.

CHAIRMAN RAY: Okay. Now that's another request by the Committee, but a request by one member of the Committee. So let's give that a 9. It's not something that the applicant needs to address themselves to if they choose not to do so. Charlie.

MEMBER BROWN: No, I don't have any other technical requirements. Thank you. Bet I don't talk at all both days. Failed to open.

I was very satisfied with the detail that the FPL presented on a number of the issues in

response to our questions. I thought that allowed me particularly, who's not an expert on a number of these subjects, to gain a reasonable understanding, I hope reasonable understanding of what's being proposed.

So other than that, I have no other comments, and staff did a good job also. So I compliment them both on answering questions.

CHAIRMAN RAY: Walter.

MEMBER KIRCHNER: No particular comment, other than thanking the applicant and the staff. I thought we had strong presentations on the geological seismic and other matters that were unique to the site. So thank you.

CHAIRMAN RAY: Jose.

MEMBER MARCH-LEUBA: Yeah. I as most other members of the Committee were concerned about the deepwater injection before we came here, and I appreciate all your presentations. I understand it much better now and me personally you have satisfied my concerns.

On a separate topic, I'm still concerned about the exceedance rule, the 500 persons per square mile and in particular I'm referring to figure, on the FSAR Figure 2.1-227, which was

presented by the applicant and there are two calculations here, one with a circle of 20 miles, another one with only land area.

I would like -- it's more of a question for the staff, if they can present us a position or a reading of what the guideline says. Should you use the Atlantic Ocean, or should you not use the Atlantic Ocean, and if you are not using Atlantic Ocean, then I would like to get a reading of why you using the swamp in the Everglades, because even though that's a land area, it's only populated by alligators too, okay. So I would like a position or reading of that reg guide from the staff in the full Committee.

CHAIRMAN RAY: Okay. Can I say it this way, see if I'm getting it right. As opposed to use of a full circle, regardless of what's within that full circle, something that was more limited to the areas of interest where population actually can exist?

MEMBER MARCH-LEUBA: Correct.

CHAIRMAN RAY: And specifically if you use the full circle, which is one reading of the regulation, you can say that the two lines don't exceed each other. They're right on top of each

other. But if you go to the land area, you don't have a factor (indiscernible). So you exceed it by 300 percent, and that would be questionable.

CHAIRMAN RAY: Yeah. As we were reminded here or pointed out, it is siting guidance that we're having a hard time understanding. I mean the regulation is citing requirements that we're having a hard time understanding what its objective or aim was, since it's not dose-related, it's not evacuation time-related.

It's just something called low population, and what was in the intent of the agency at the time I think is part of the question. The guidance, what you're asking for, is just the staff's effort to try and understand that.

But at the root, there is the question of what is this intended to do really, as it's implemented I guess I would say, and I'll leave it at that.

MEMBER MARCH-LEUBA: Even though we concluded a month ago that there is no relationship with the evacuation plan, I respectfully disagree. I mean if I want to put a nuclear power plant in downtown Los Angeles, where clearly I cannot evacuate anybody from there, that would be a bad

siting.

CHAIRMAN RAY: Yeah. So it's evacuation-related, but one might say maybe it's somehow related to, you know, the kind of thought process that was involved in the TID era, and I just -- I don't want to speculate any further here on the record, but your point's taken. Pete.

MEMBER RICCARDELLA: No. I have no further comments. I think it reflects a lot of good work, and I hope that it isn't just an exercise. I hope this plant actually gets built someday.

CHAIRMAN RAY: Thank you. Dennis.

MEMBER BLEY: Just a couple of things. Most of my more significant concerns have been pretty well addressed. This is my own opinion.

We seem to be obsessing on one criteria from one reg guide. We've been told many times reg guides aren't regulations, and there are many different cases where people don't meet reg guides but they offer arguments that the staff accepts.

If we want to delve into this further, I would rather see us do it in a separate letter to the EDO about that reg guide and is it up to date, and certainly this isn't the only plant that won't meet that criteria. The regulation wants to ensure

that the safety in terms of dose and that emergency planning can work, and they've demonstrated that pretty well, at least to my satisfaction.

I'd rather see it show up somewhere else. That's -- and I'm not writing the letter.

CHAIRMAN RAY: You're not drafting the letter you mean. You're signing the letter, but the --

(Simultaneous speaking.)

(Laughter.)

CHAIRMAN RAY: I would welcome concluding that we just won't address this whatsoever. I'm a little concerned though, since it has been addressed by the staff and the applicant, and it is a -- something that does involve a regulation, yeah, a regulation, even though it's involved through the device of guidance. To say nothing about it is something I'd have to ponder. But I would welcome that as a result.

MEMBER BLEY: I would point out that neither the staff nor the applicant has written down that this isn't a whole lot bigger than 500. They haven't written it down anywhere.

CHAIRMAN RAY: They've written it down --

MEMBER BLEY: They've written down that it meets the dose requirements and meets the evacuation capability.

CHAIRMAN RAY: But they've also written down that they considered the alternatives called for by the guidance under these circumstances, and this is the best site given the alternatives that they were required to look at.

MEMBER BLEY: They have, but they had a lot of other criteria.

CHAIRMAN RAY: Oh yes, but the criteria was triggered by the exceedance. But again, let me say I'm very happy to say this is the end, we don't hear no more of this subject until we write a generic letter. That's going to be up to the committee to decide. But I'll put something --

MEMBER BLEY: Any member could put it forward.

CHAIRMAN RAY: I'll put something forward as a trial balloon, how's that? But in any event --

MEMBER BLEY: I'd be delighted.

CHAIRMAN RAY: In any event, I appreciate your thoughts on this subject. Well to conclude, of course everybody's expressed what is --

MR. COMAR: This is Manny Comar.

CHAIRMAN RAY: Yeah.

MR. COMAR: We have the staff member here who can talk about the aviation accident and the frequencies and the risk involved with it. Would you like to?

CHAIRMAN RAY: What kind of accident?

MEMBER STETKAR: Sure, if he's here.

CHAIRMAN RAY: Oh, the aircraft accident.

MEMBER STETKAR: I'd like to hear something on that.

CHAIRMAN RAY: All right. So we'll interrupt the conclusion and we'll continue the record and get the information that John has been seeking. Is that all right John?

MEMBER STETKAR: Fine with me.

CHAIRMAN RAY: You want to come forward, just so we're not all turning sideways to --

(Pause.)

CHAIRMAN RAY: And you press the little button there to start with, thank you.

MEMBER STETKAR: It's where it says "push."

MALE PARTICIPANT: As close to you as it

can be.

CHAIRMAN RAY: It says "push" but it's hard to read.

MALE PARTICIPANT: It's actually not a button. We need to get buttons.

PARTICIPANT: We have a human factors problem.

MR. PATTERSON: I'll say again. I'm Malcolm Patterson. I'm with the PRA and Severe Accidents Branch in the Office of New Reactors. This site had a slight exceedance of aviation accidents, above what was assumed in the DCD. However, the consequences of aviation accidents is a very, very small contributor to CDF and BLERV (phonetic).

And on that basis, we considered it to be acceptable, the same way we accept natural events that are more frequent than we'd like, but very low in consequence. If the contribution to risk is small enough that it's not going to effect on risk, we found it acceptable.

MEMBER STETKAR: Malcolm, you weren't here. This may help you for the full Committee meeting, but you weren't here for the discussion and some things might have gotten lost in the

translation. I asked the applicant what was the technical basis for the specific conditional core damage probability that they use to draw that conclusion.

I'm not arguing necessarily with the high level conclusion that the core damage frequency is less than 10 to the minus 8. But they had an exceedingly small conditional core damage problem. When I pressed them on that, I didn't get an answer basically.

And then it came up when I asked the staff, and I was led to believe that the staff had done an independent conditional core damage probability calculation. Okay, thanks. So you did not.

MR. PATTERSON: We looked at the PRA.

MEMBER STETKAR: Yeah, okay. Thank you.

CHAIRMAN RAY: Is that all then? So it's not just a question of what is the consequence of the plane crash that we're not answering that question here now. Why did we pick this consequence rather than that consequence? It's the scenario.

MEMBER STETKAR: It's the scenario. Florida Power and Light and the assembled multitudes sitting behind me understand what the question is

and that has been answered.

CHAIRMAN RAY: Fine. I just want to be clear in my own mind. Thank you.

MR. PATTERSON: Thanks.

CHAIRMAN RAY: Okay. As I was saying, I won't add to what others have said. I think that the -- Peter and I will work on getting a draft letter ready for the full Committee meeting and share that with those who may be interested in it, and I take the Chairman's input as input to that, relative to the two things that we said at the outset we needed to recognize as things we had to experience doing, exceeding the guidance on population being one.

Hopefully we'll get everything in order and have a successful full Committee meeting. If there's nothing else, we'll adjourn this subcommittee meeting. Seeing nothing, we stand adjourned.

(Whereupon, the above-entitled matter went off the record at 3:55 p.m.)

Turkey Point Nuclear Power Plant

Units 6 & 7

Combined License Application

August 19, 2016

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- Section 2.5 Geology, Seismology, and Geotechnical Engineering
- Chap. 3 Design Of Structures, Components, Equipment and Systems
- Section 13.3 Emergency Planning
- Chap. 19 Probabilistic Risk Assessment
- Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations
- Chap. 21 Design Changes Proposed in Accordance with ISG-11

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- **Section 2.5 Geology, Seismology, and Geotechnical Engineering**
- Chap. 3 Design Of Structures, Components, Equipment and Systems
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Turkey Point Nuclear Plant Units 6 & 7

Section 2.5 – Geology, Seismology, and Geotechnical Engineering

Paul C. Rizzo
President
Paul C. Rizzo Associates, Inc.

Section 2.5 – Geology, Seismology, and Geotechnical Engineering

- Site-Specific Geology Investigations
- Settlement Analyses
- Bearing Capacity
- Liquefaction Analysis
- Evaluation of Karst Conditions
- Grout Plan/ITAAC
- Regional Geology & Tectonics
- Surface Deformation
- Seismicity/Seismic Source Characterization
- Ground Motion Model
- Probabilistic Seismic Hazard Analysis
- Shear Wave Velocity Profiles
- Ground Motion Response Spectra
- CEUS SSC Sensitivity Analysis

Site Specific Evaluations

- **Site geology investigations, including evaluation of potential for karst conditions**
- **Foundation condition, soil/rock parameters, and geotechnical analyses**
  - Index properties, rock mass characterization, shear wave velocity profiles, strength properties, dynamic properties, stiffness characterization
  - Settlement, bearing capacity, liquefaction potential, site uniformity, etc.
- **Section 2.5.4 analyses (settlement, bearing capacity, etc.) use updated material properties [initial (2008) and supplemental (2013) investigations]**
- **Analyses in Section 2.5.2 and 3.7 (SSI, site response) consider updated material properties by performing sensitivity analyses**

Turkey Point Nuclear Plant Units 6 & 7

Site Stratigraphy

EL (ft)	Formation	Lithology
	Muck/Peat	elastic silt and peat
-5	Miami Limestone	sandy, oolitic limestone (Pleistocene)
-27	Key Largo Limestone	coralline, vuggy limestone (Pleistocene)
-49	Ft. Thompson	limestone w/ moldic porosity, shells, sand (Pleistocene)
-115	Upper Tamiami	silty sand with gravel (Pliocene)
-168	Lower Tamiami	sandy silt with silty clay (Upper Miocene to Pliocene)
-218	Peace River	silty sand (Middle to Upper Miocene)
-455	Arcadia	wackestone, packstone, mudstone (Oligocene to Lower Miocene)

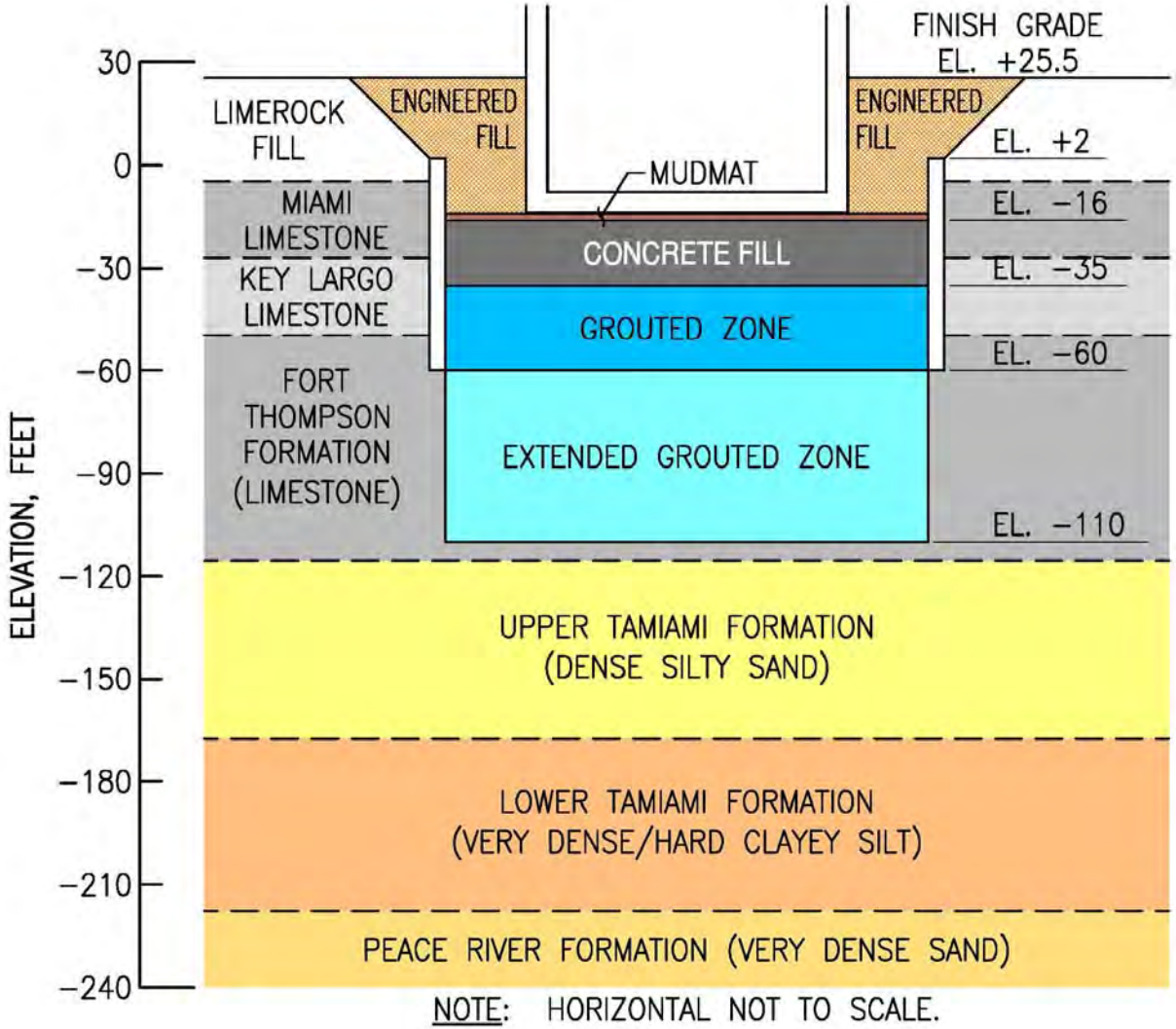
Foundation
~EL -16 ft

Depth to 2B
(~EL -336)
Approximate
Depth of Influence

Adapted from FSAR Table 2.5.4-209

Turkey Point Nuclear Plant Units 6 & 7

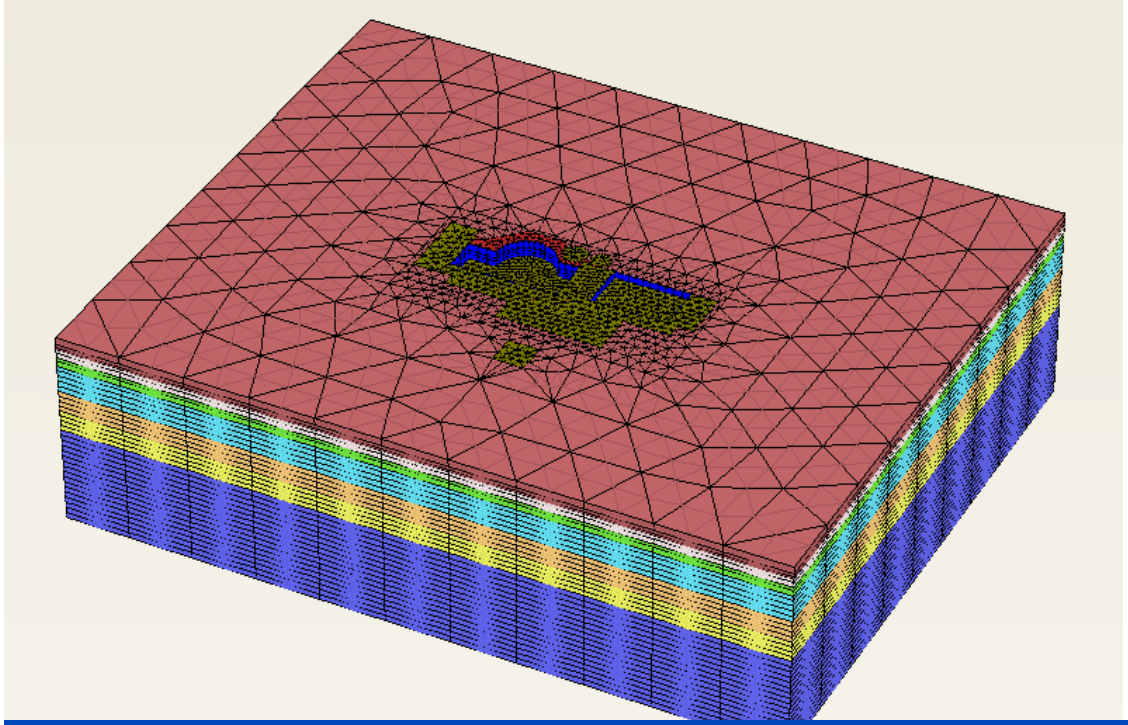
Foundation Conditions



Adapted from FSAR Appendix 3KK Figure 3.1-2

Turkey Point Nuclear Plant Units 6 & 7

Settlement Analyses



- Finite Element Models
- Classical Hand Calculations

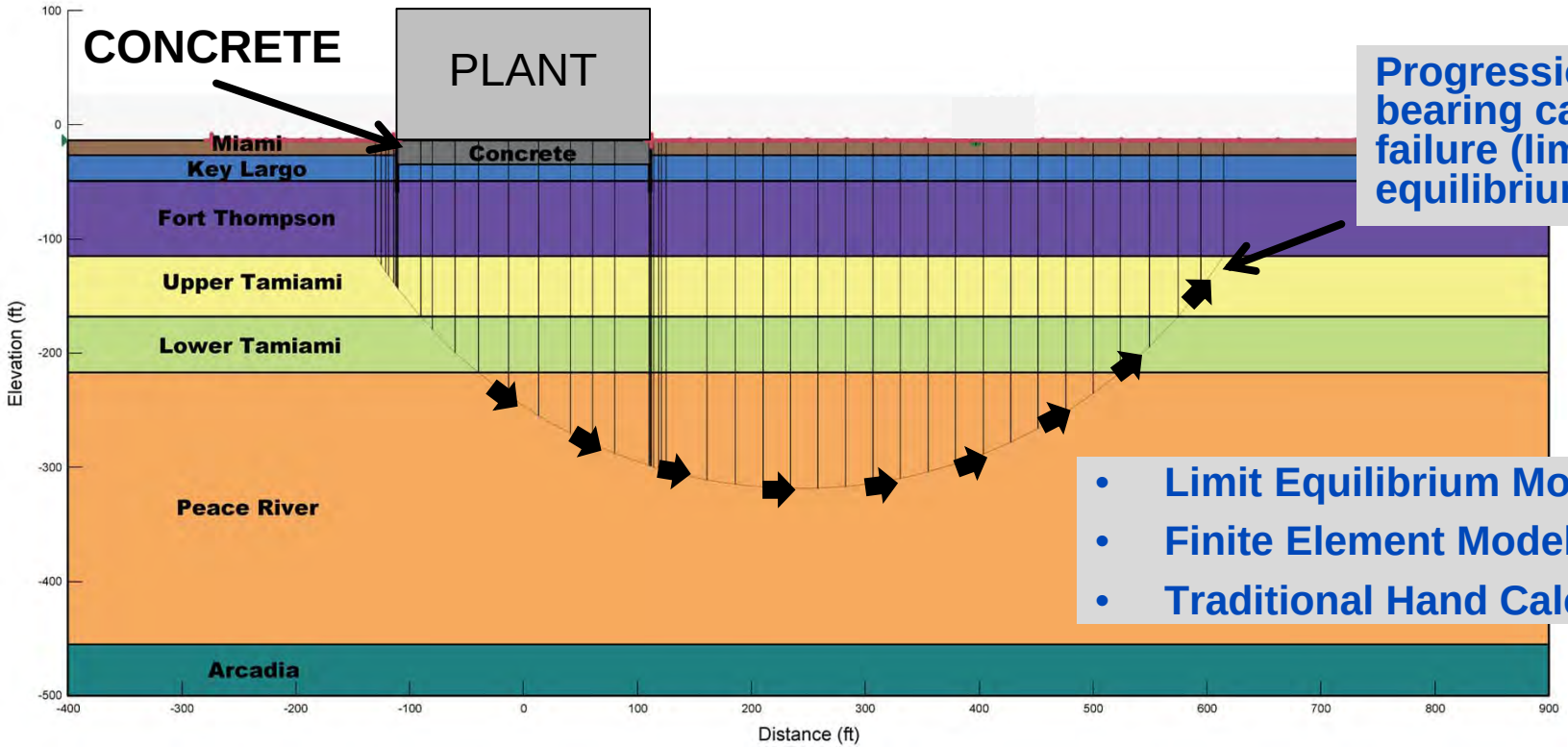
DCD Criteria Met:

Predicted settlement estimates are within the limits provided by AP1000 DCD (6-inch total settlement, 3-inch differential settlement, and 0.5 in/50 ft tilt)

Adapted from FSAR Figure 2.5.4-260

Turkey Point Nuclear Plant Units 6 & 7

Bearing Capacity



Progression of bearing capacity failure (limit-equilibrium model)

- **Limit Equilibrium Models**
- **Finite Element Models**
- **Traditional Hand Calculations**

Adapted from FSAR Figure 2.5.4-257

DCD Criteria Met:

39 ksf static and 41 ksf dynamic bearing capacity are larger than DCD minimum requirements (8.9 ksf static and 35 ksf dynamic)

Liquefaction Analysis

- **No liquefaction based on SPT, CPT, and V_s data**
- **Conservative Assumptions:**
  - No credit for age, over-consolidation or cementation
  - Input Mw (7.3) - highest EQ magnitude from controlling EQ magnitudes
  - Input PGA (0.1g) – higher than GMRS PGA (0.06g)

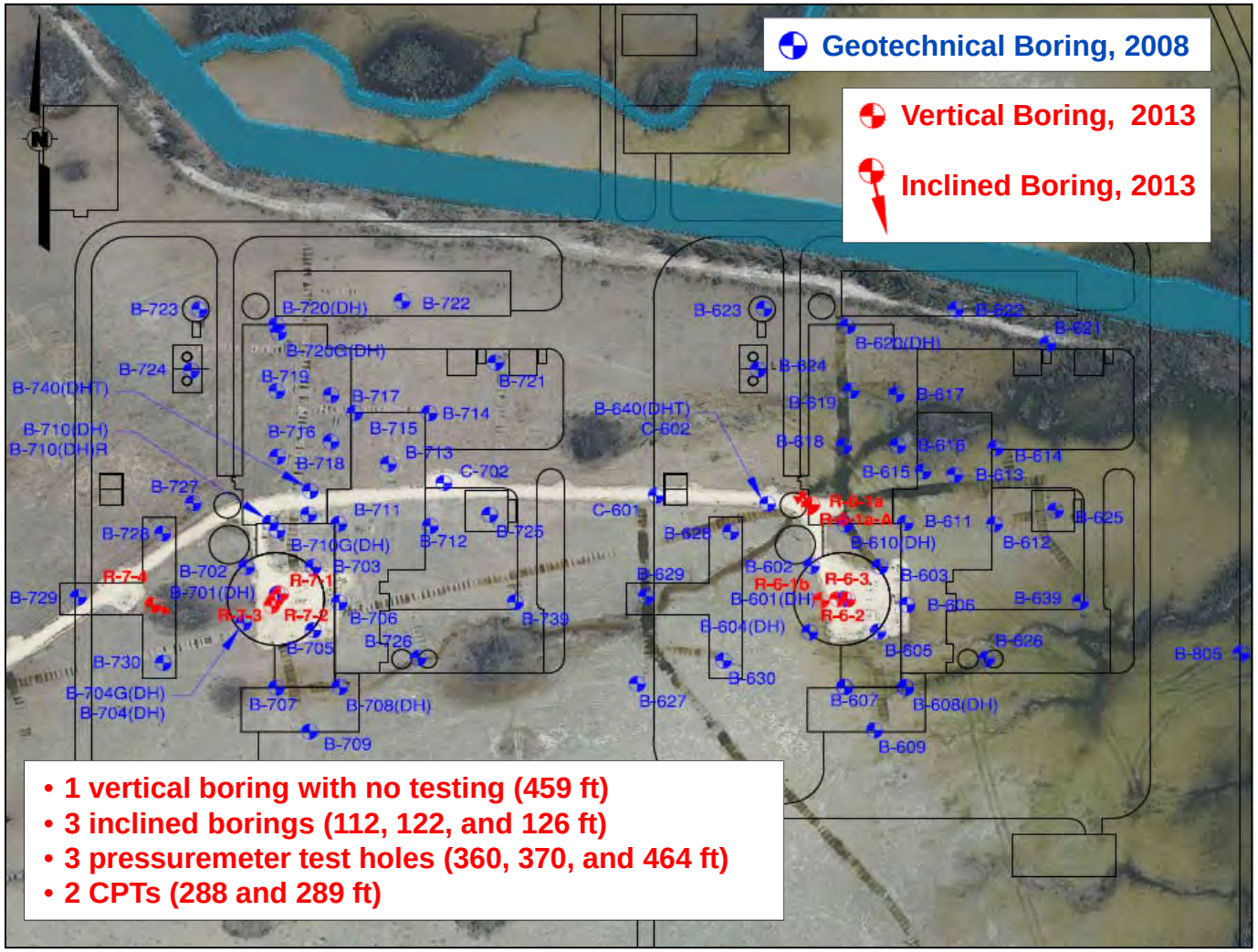
Liquefaction is not a concern.

Evaluation of Karst Conditions

- Only relevant geologic hazard to be addressed is postulated karst deformation
- No karst deformation (cavities/voids or collapses) shown on isopach or structure contour maps
- No caves, surface sinkholes, springs, or paleo-collapse/sag features at the site

Turkey Point Nuclear Plant Units 6 & 7

Site Investigation, 2008 and 2013



Adapted from FSAR Figure 2.5.4-202

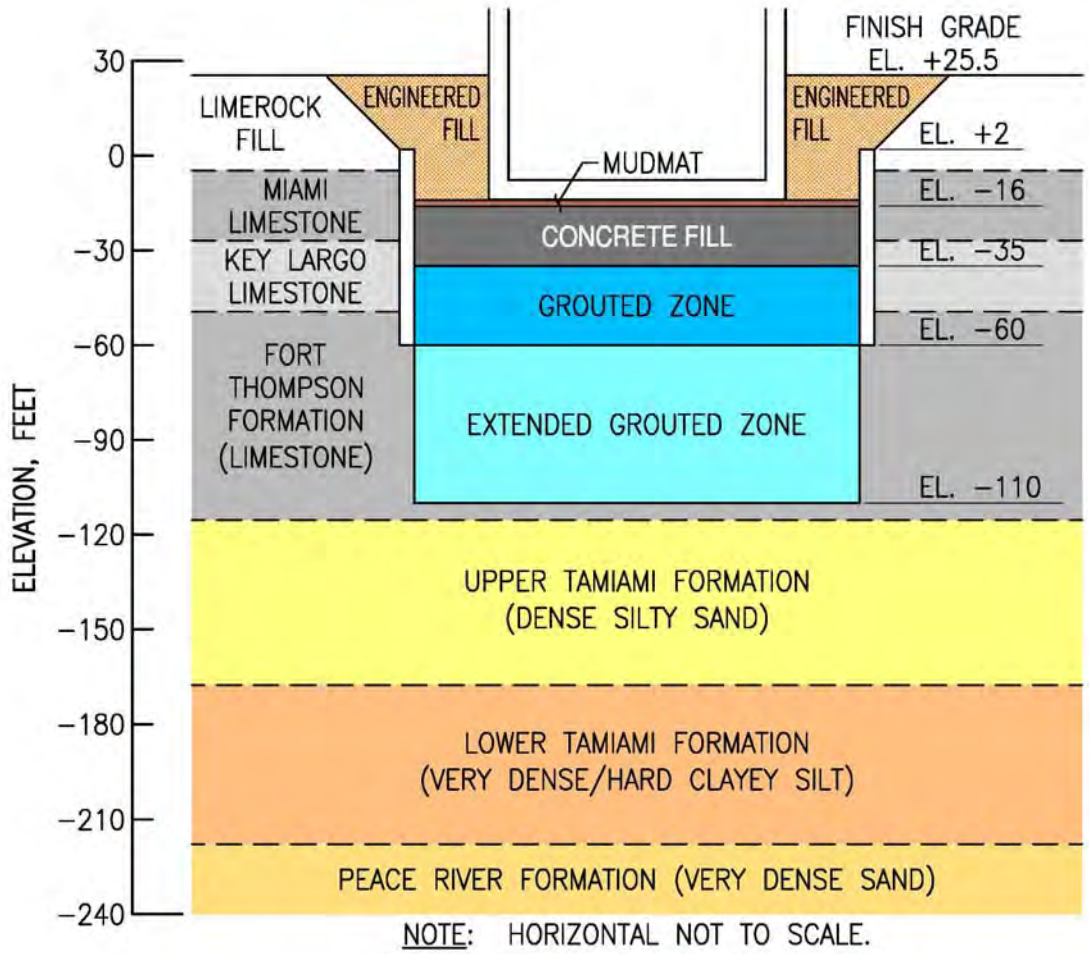
Evaluation of Karst Conditions

- **Observations in Vertical Borings:**
  - Tool/rod drops = 0.3% (20 ft cumulative) of 7,918 ft of core
  - Individual tool/rod drops = 0.4 ft to 4 ft on Site
  - Individual tool/rod drops ≤ 1.5 ft within Unit 6 and 7 footprints
- **Observations in 3 Inclined Borings (2013):**
  - Inclined borings designed to find cavities/voids under the vegetated depressions and drainage channels at the site
  - Tool/rod drops = 4% (15 ft cumulative) of 356 ft of core
  - Individual tool/rod drops = 0.3 to 2.5 ft

Tool drop size is limited to 1.5 ft within Unit 6 and 7 building footprints. Frequency of total drops is < 0.5% site wide.

Grout Plan/ITAAC Table 3.8-6

- Minimizes dewatering effort
- Provides barrier to upward flow
- Minimizes flow through vugs, joints, fractures, and bedding planes in the Key Largo and Fort Thompson



Adapted from FSAR Appendix 3KK Figure 3.1-2

Grout Test Program

- Validate grouting design/techniques
- Confirm closure criteria for individual grout stages
- Confirm acceptance criteria (residual hydraulic conductivity) for completed areas of the Grouted Zone and Extended Grouted Zone

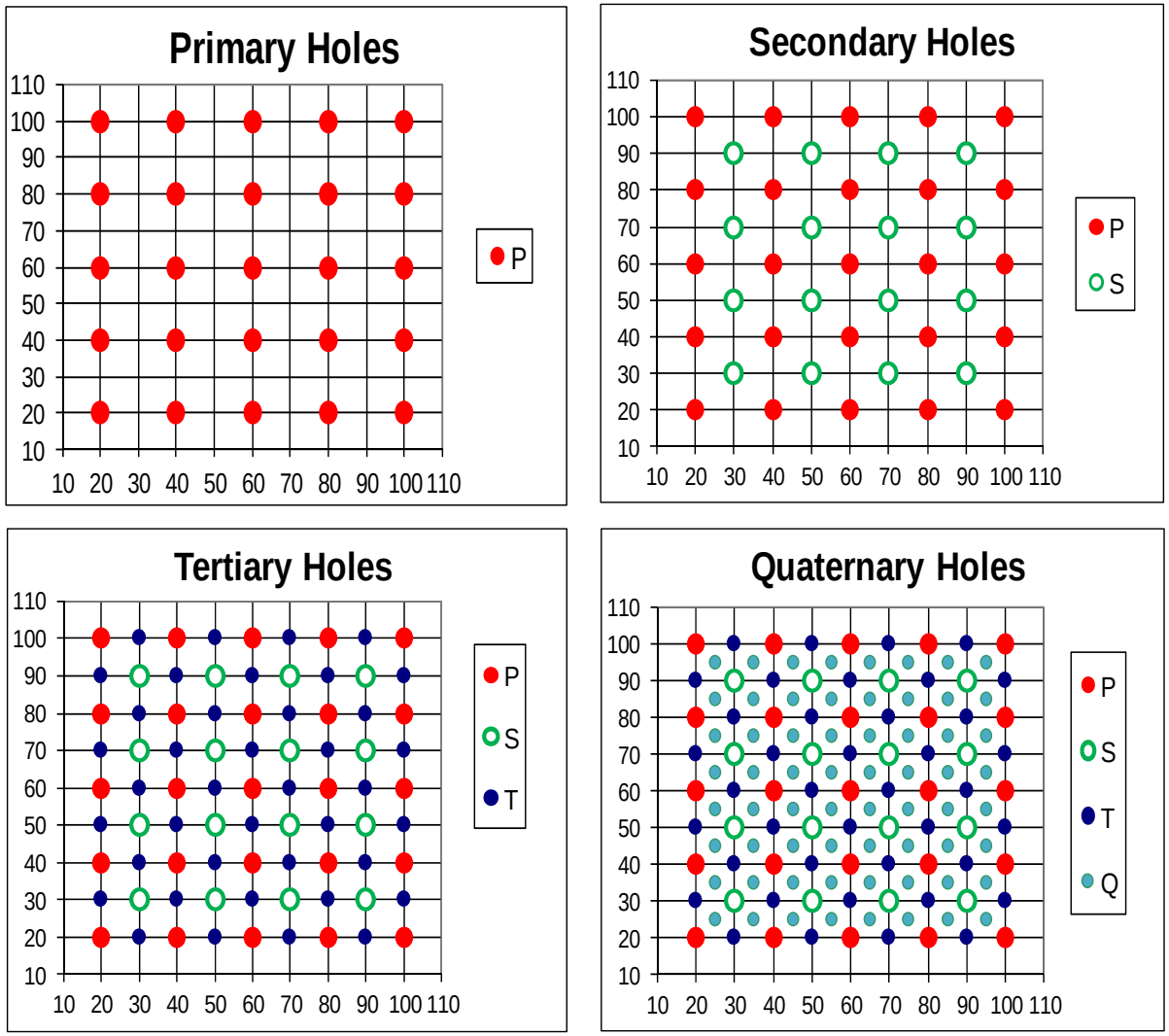
Grout Plan/ITAAC Table 3.8-6

Primary holes spaced ≤ 20 feet on center, secondary and higher order holes split-spaced

Grouted Zone (El. -35 ft to El. -60 ft)	Extended Grouted Zone (El. -60 ft to El. -110 ft)
• Primary & Secondary holes • Tertiary & Quaternary holes (if necessary)	• Primary holes • Secondary holes (if necessary)
• Any remaining voids structurally insignificant	• Any remaining voids ≤ 20 ft

Turkey Point Nuclear Plant Units 6 & 7

Grout Plan/ITAAC Table 3.8-6 (Cont.)



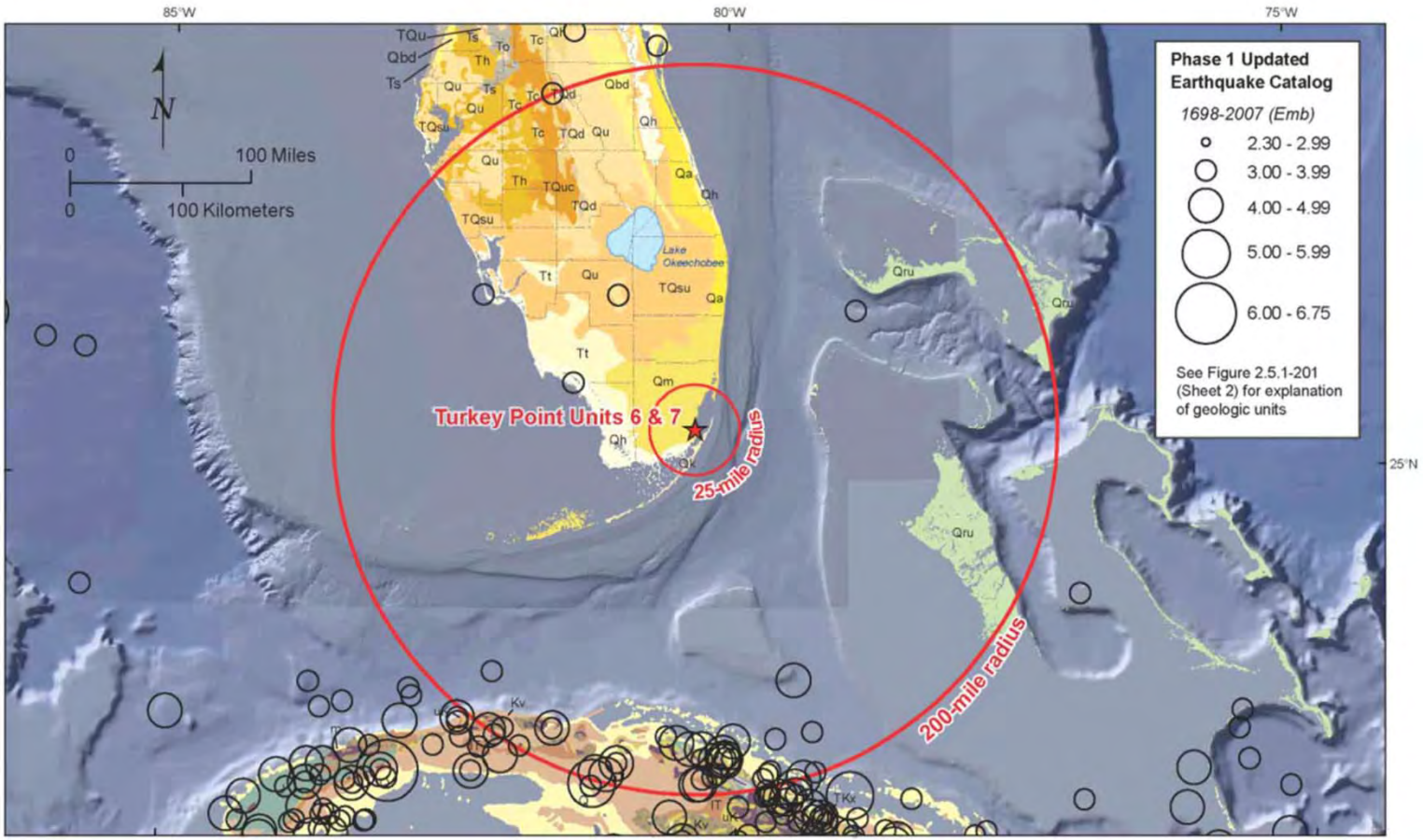
Adapted from FSAR Appendix 2CC Figure 2CC-239

Regional Geology & Tectonics

- **200-mile site region includes:**
  - Southern portion of the Florida Peninsula and offshore Platforms
  - Northern Cuba
- **Significant differences exist between the physiography, geologic history, and current seismotectonic setting of these two areas.**
  - Southern Florida
    - Passive continental margin
    - Generally flat-lying and undeformed limestones, mudstones, and sandstones deposited over crystalline basement rocks
    - Rates of seismicity are very low
  - Northern Cuba
    - Complex geologic and tectonic history recorded by faulted and deformed metamorphic, volcanic, and carbonate rocks
    - Plate boundary shifted from north to south of Cuba by the Oligocene Epoch. Modern North America-Caribbean plate boundary is located >400 miles from Turkey Point Nuclear Power Plant
    - Rates of seismicity in northern Cuba are low to moderate. Rates of seismicity south of Cuba along the modern plate boundary are very high

Turkey Point Nuclear Plant Units 6 & 7

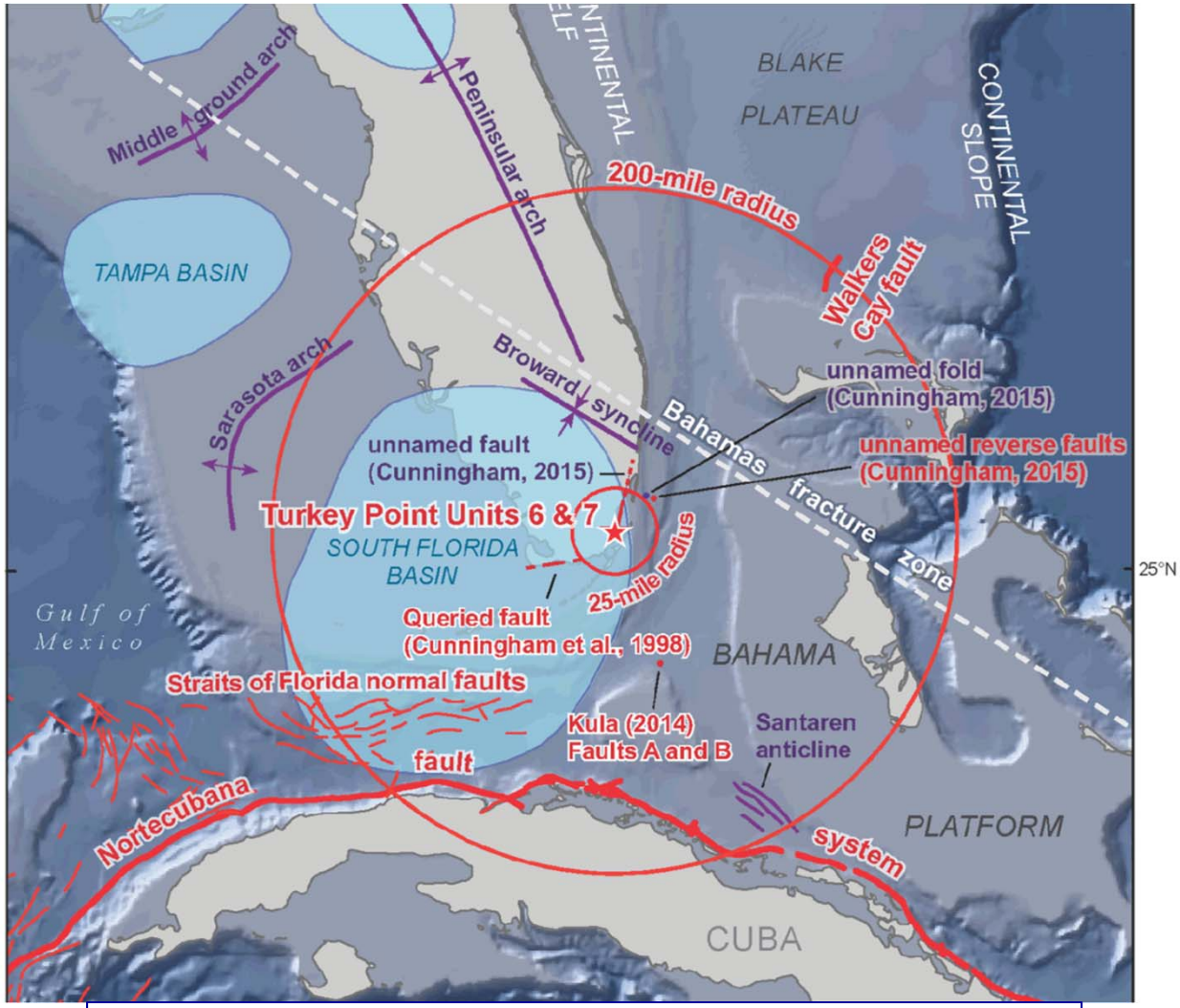
Site Regional Geology and Seismicity



FSAR Figure 2.5.3-203 Site Region Seismicity

Turkey Point Nuclear Plant Units 6 & 7

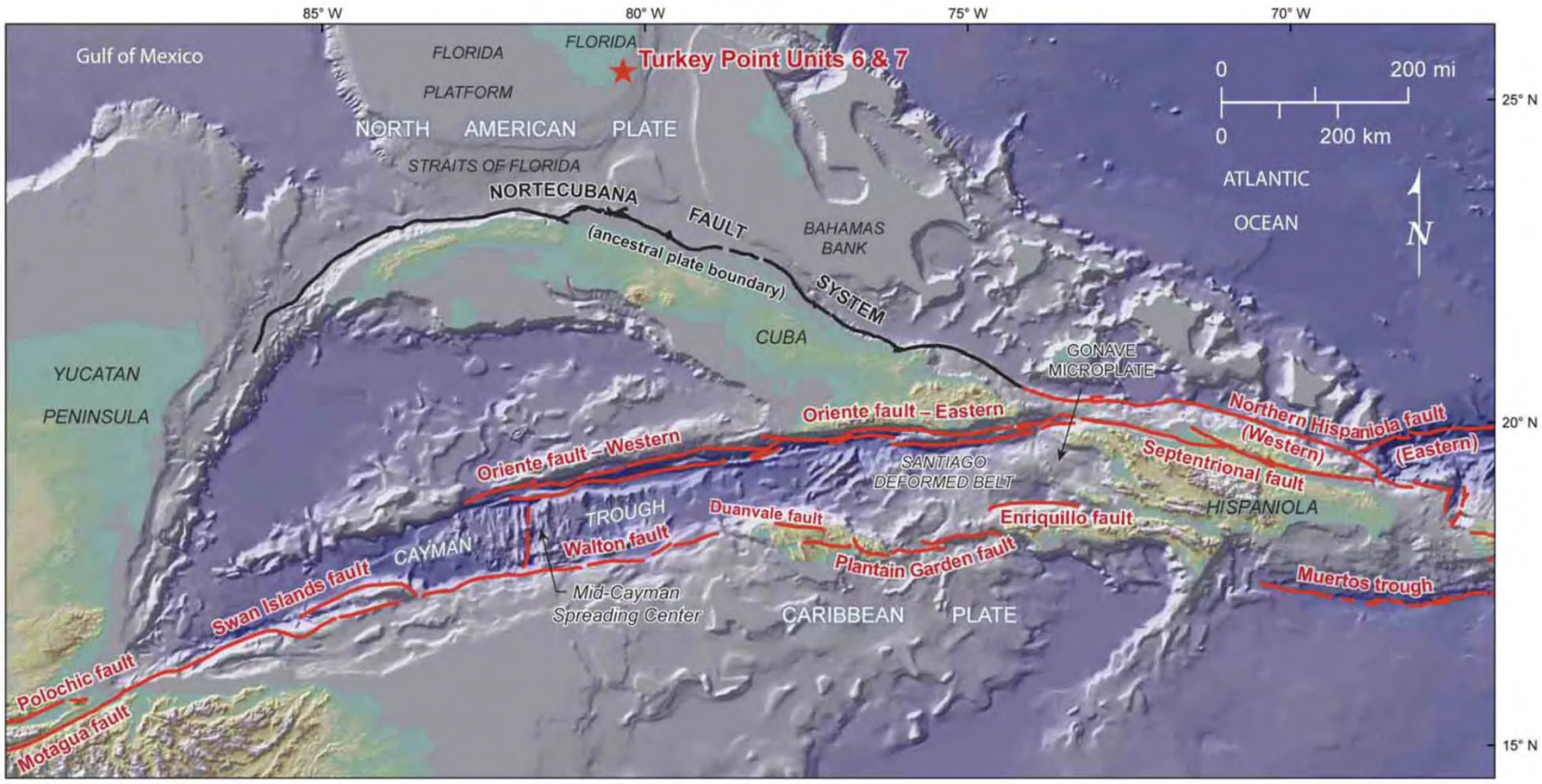
Regional Tectonic Map (200-mi.)



Adapted from FSAR Figure 2.5.1-229 Regional Tectonic Features

Turkey Point Nuclear Plant Units 6 & 7

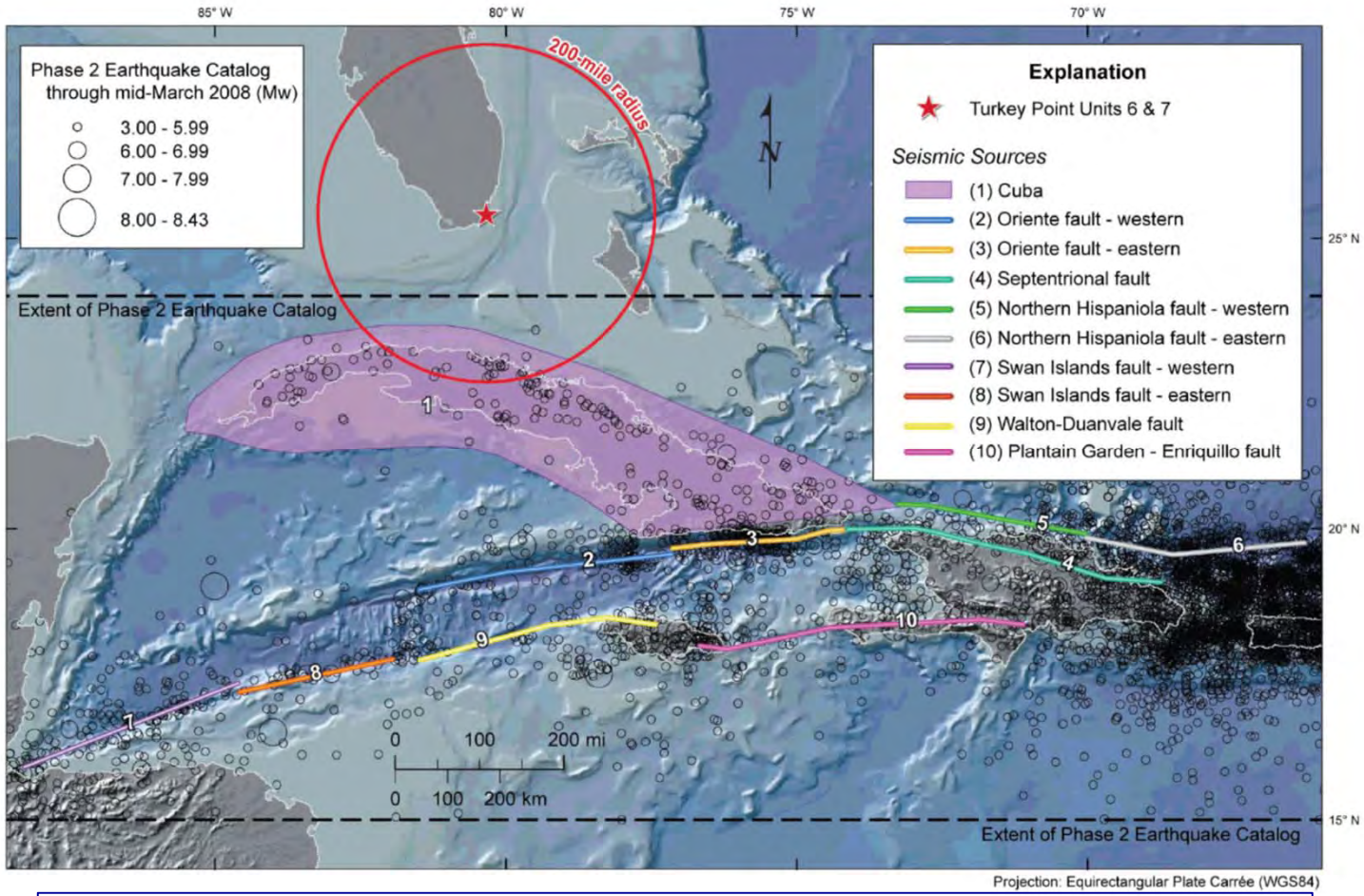
Tectonic Map of the Northern Caribbean-North America Plate Boundary



FSAR Figure 2.5.1-202 Tectonic Map of the Northern Caribbean-North America Plate Boundary

Turkey Point Nuclear Plant Units 6 & 7

Cuba and Northern Caribbean Seismic Source Model Sources



FSAR Figure 2.5.2-217 Cuba and Northern Caribbean Seismic Source Model Sources

Surface Deformation

- **Geology Investigations**
  - Extensive literature reviews & interviews with local experts
  - Geologic and geomorphic interpretation of aerial photography and field reconnaissance focused on potential tectonic and non-tectonic surface deformation in the site vicinity
- **Conclusion**
  - No traceable tectonic lineaments
  - No evidence of capable or Quaternary tectonic surface deformation within the 25-mile radius site vicinity
  - The only geologic hazard identified in the site area is potential surface deformation related to carbonate dissolution.
    - As presented earlier, the potential for dissolution at the site is accounted for in foundation design

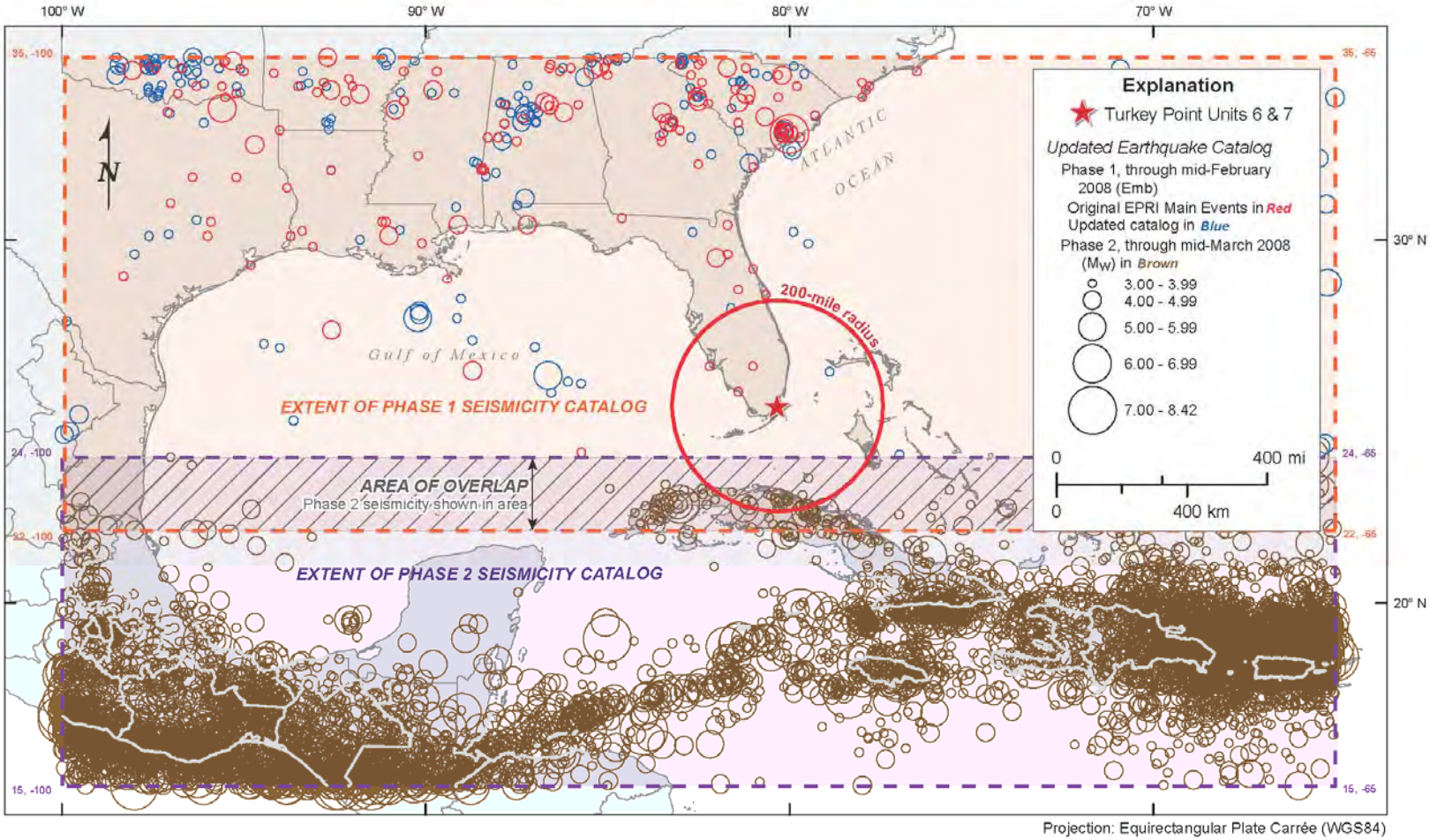
Seismicity

DEVELOPMENT OF THE PROJECT EARTHQUAKE CATALOG

- **Phase 1: Update of the EPRI-SOG (1988) catalog for CEUS**
  - EPRI-SOG (Seismicity Owners Group) catalog complete up through 1984: updated to mid-Feb. 2008
  - 34 earthquake catalogs
  - Objective: all earthquakes of uniform body wave magnitude "Rmb" ≥ 3.0 or maximum intensity $I_0 \geq$ IV
- **Phase 2: Development of a Cuba and Caribbean catalog**
  - Developed earthquake catalog complete to mid-March 2008
  - 23 earthquake catalogs
  - Objective: all earthquakes of uniform moment magnitude $M_W \geq 3.0$

Turkey Point Nuclear Plant Units 6 & 7

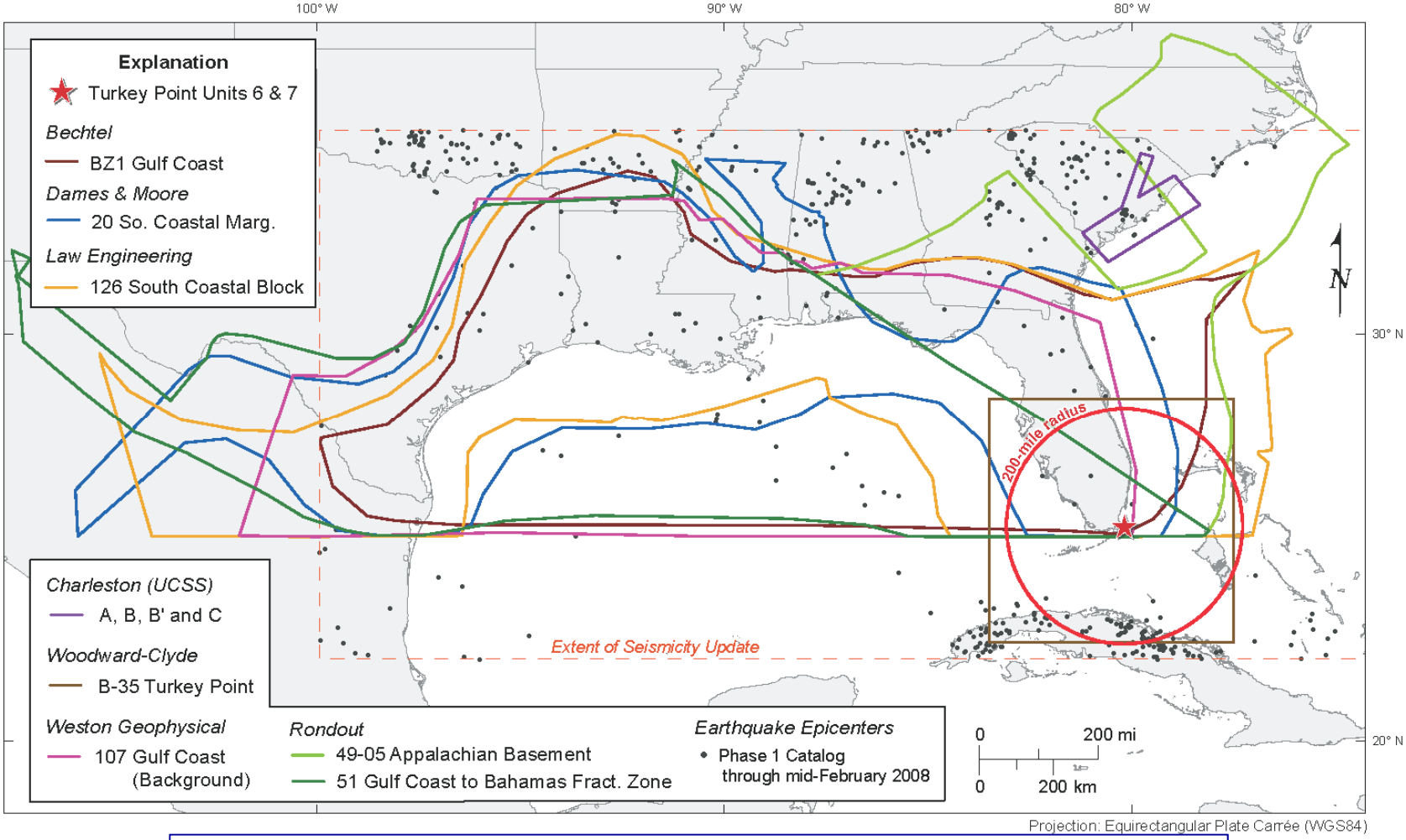
Seismicity



FSAR Figure 2.5.2-201 Seismicity in the Study Region, Phase 1 and Phase 2

Turkey Point Nuclear Plant Units 6 & 7

Seismic Source Characterization [SSC]: EPRI-SOG + UCSS



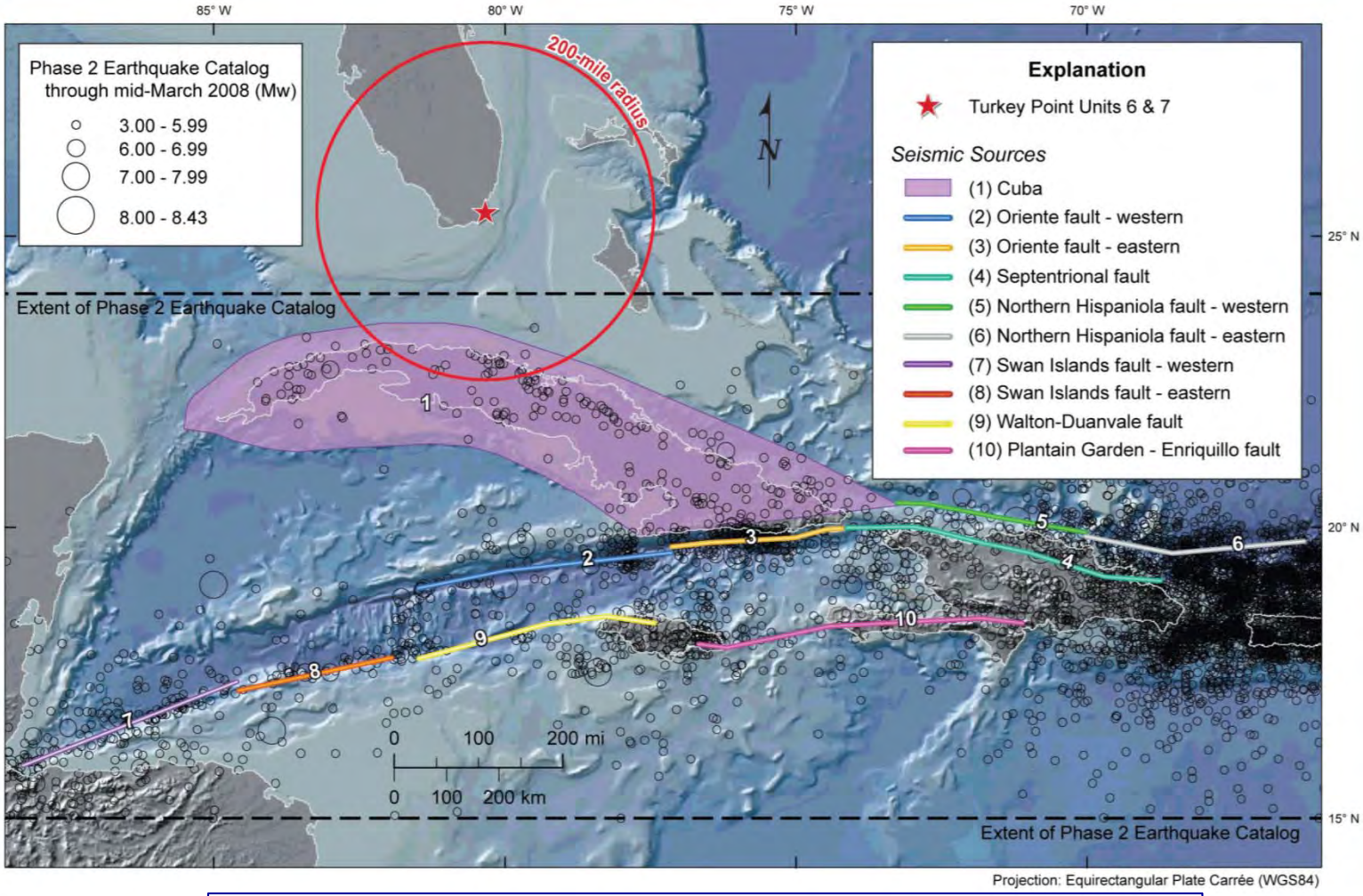
FSAR Figure 2.5.2-203 EPRI Seismic Source Zones and Updated Charleston Seismic Source (UCSS) Model Sources

Seismic Source Characterization [SSC]: Update

- **Modifications to the six EPRI-SOG seismic source models:**
  - Evaluated activity rates for seismic sources covering the Gulf of Mexico and near Atlantic Ocean
  - Supplemented EPRI-SOG seismic sources for 200-mile radius site region
  - Updated Mmax of seismic sources given updated Phase 2 earthquake catalog
- **Adoption of the Updated Charleston Seismic Source (UCSS) initially developed for the Vogtle Early Site Permit Application**
- **Development of Caribbean seismic sources:**
  - Cuba (single area source)
  - North America-Caribbean plate boundary region (9 fault sources)

Turkey Point Nuclear Plant Units 6 & 7

Seismic Source Characterization [SSC]: Update



FSAR Figure 2.5.2-217 Cuba and Northern Caribbean Seismic Sources

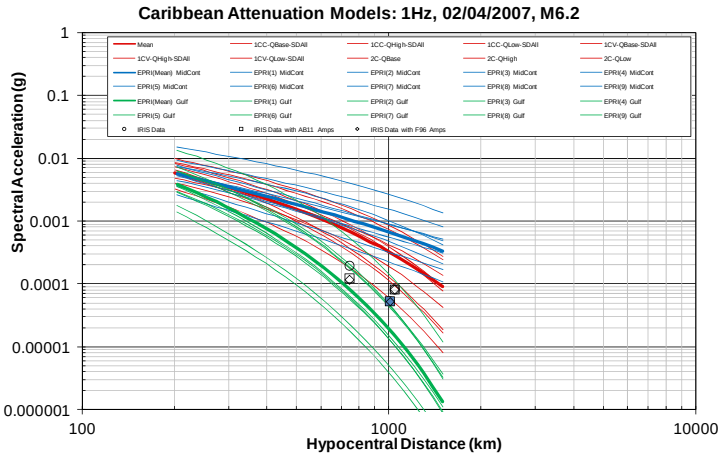
Ground Motion Model [GMM]

- **CEUS**
  - Replaced EPRI (1988) GMM with EPRI (2004, 2006) GMM [Mid-Continent]
- **Cuba and Caribbean**
  - As no appropriate GMM was available, one was developed for this COLA
  - Guided by published GMM for Puerto Rico, stochastic simulations performed for a range of source, path, and crustal amplification factors
  - Compared new Caribbean GMM with 5 IRIS GM recordings
    - -- New GMM marginally conservative [high] compared with observations
  - Compared new Caribbean GMM with EPRI (2004) Mid-Continent and Gulf Coast
    - -- Gulf Coast < new Caribbean GMM < Mid-Continent
  - Six ground motion attenuation experts were asked to review and comment on both the methodology and results
    - -- Found the Caribbean GMM acceptable

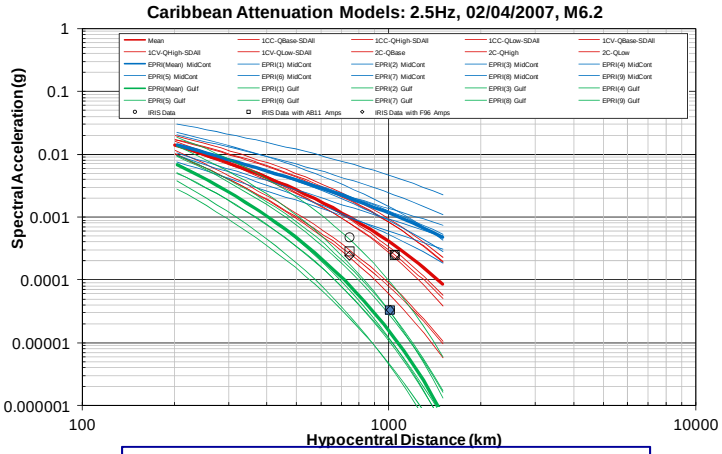
Turkey Point Nuclear Plant Units 6 & 7

Ground Motion Model [GMM]

FSAR Figure 2.5.2-260a Map Showing the Earthquake Location for the 02/04/2007 Cuba Region Earthquake (Mw 6.2), the IRIS Station Locations Used in the Analysis, and Turkey Point Units 6 & 7 Site Location



FSAR Figure 2.5.2-260b: 1 Hz



FSAR Figure 2.5.2-260c: 2.5 Hz

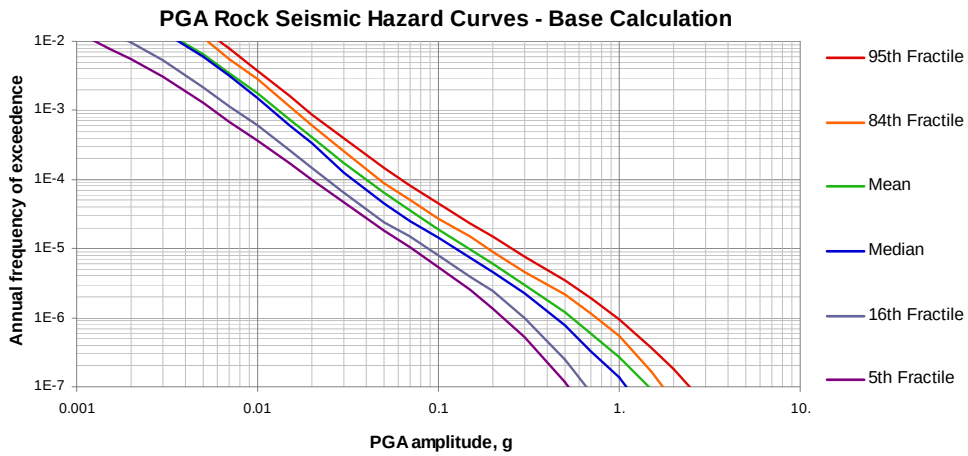
Blue:	EPRI (2004) Mid-Cont.
Red:	Caribbean GMM
Black symbols:	IRIS data
Green:	EPRI (2004) Gulf Coast

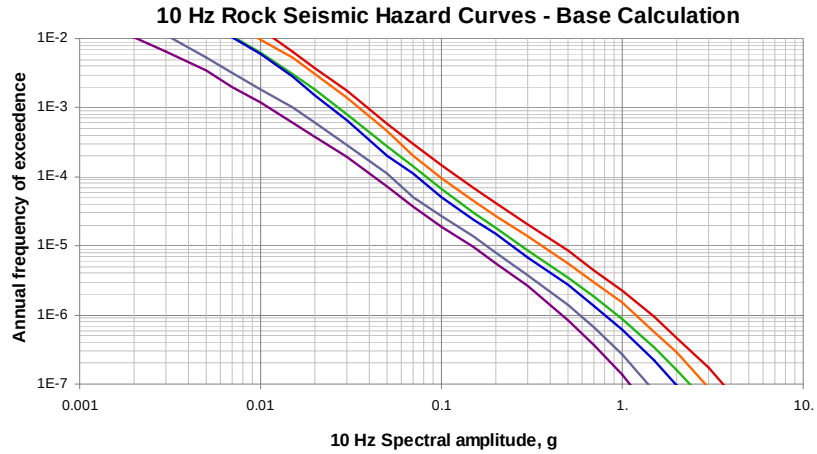
Probabilistic Seismic Hazard Analysis (PSHA)

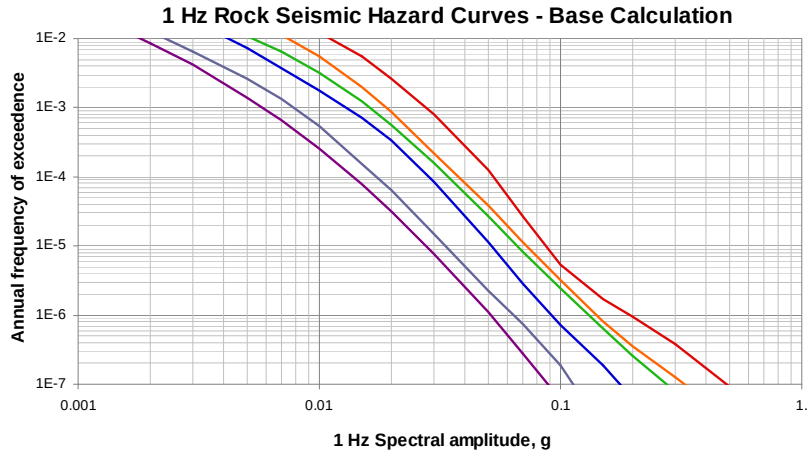
- **Horizontal Hard Rock Ground Motions**
  - EPRI (2004, 2006) & Caribbean GMM hazard curves: PGA, 25, 10, 5, 2.5, 1, & 0.5 Hz
  - "Hard rock": shear-wave velocity of 9,200 ft/sec [11,400 ft deep]
- **PSHA Deaggregation**
  - Magnitude and Distance
    - -- "Controlling earthquakes" for high-frequency [HF: 5 to 10Hz] and low-frequency [LF: 1 to 2.5Hz] portions of the ground motions for a given mean hazard level
    - -- Following Reg. Guide 1.208, separate HF and LF rock response spectra are used for input to site response per Approach 2A of NUREG/CR-6728
  - Seismic Sources
    - -- Hazard curves from discrete sources give an alternate view of the seismic sources contributing most to the total hazard
      - LF hazard at 10^{-4} almost solely from Cuba/Caribbean; 10^{-5} dominated equally by Cuba/Caribbean and Charleston, then moderately by local sources
      - HF hazard dominated by local CEUS sources

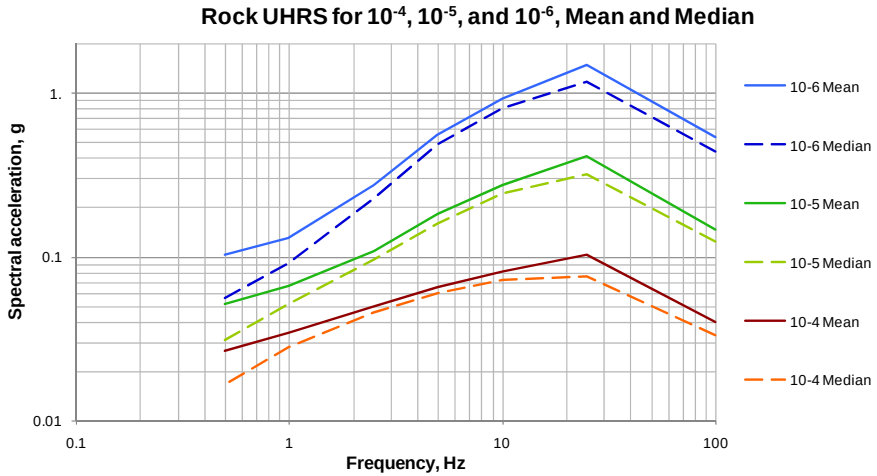
Turkey Point Nuclear Plant Units 6 & 7

Probabilistic Seismic Hazard Analysis









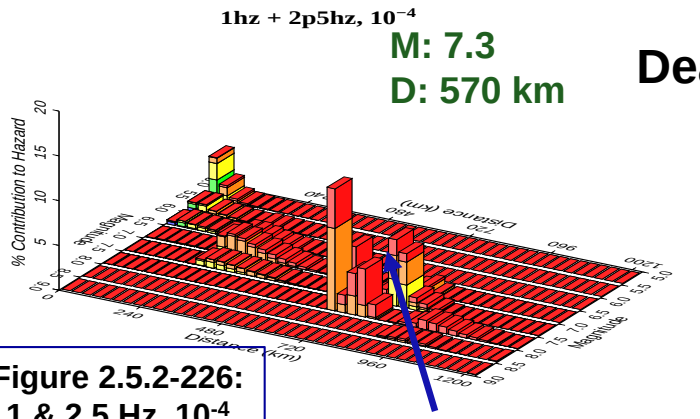
Figures 2.5.2-218, -220, & -223 Mean and Fractile Rock Seismic Hazard Curves

Figure 2.5.2-225 Mean and Median Rock UHRS for 1E-04, 1E-05, and 1E-06

Turkey Point Nuclear Plant Units 6 & 7

Probabilistic Seismic Hazard Analysis

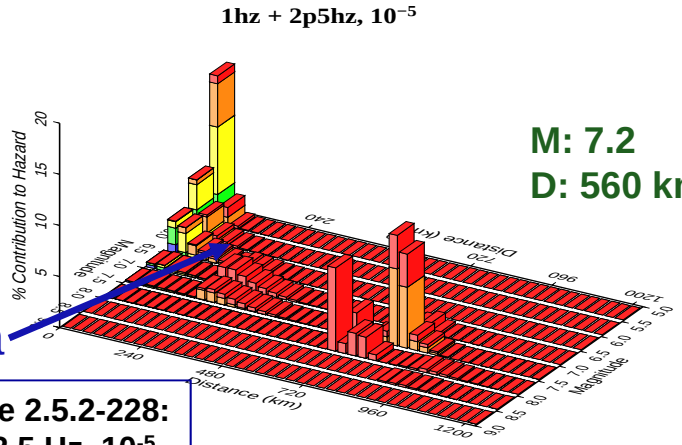
M and D Deaggregation



M: 7.3
D: 570 km

Caribbean and Charleston

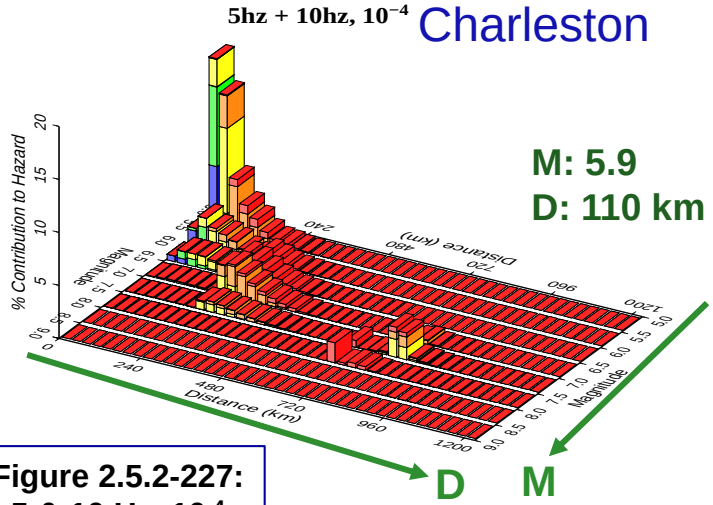
Figure 2.5.2-226: 1 & 2.5 Hz, 10^{-4}



M: 7.2
D: 560 km

Cuba

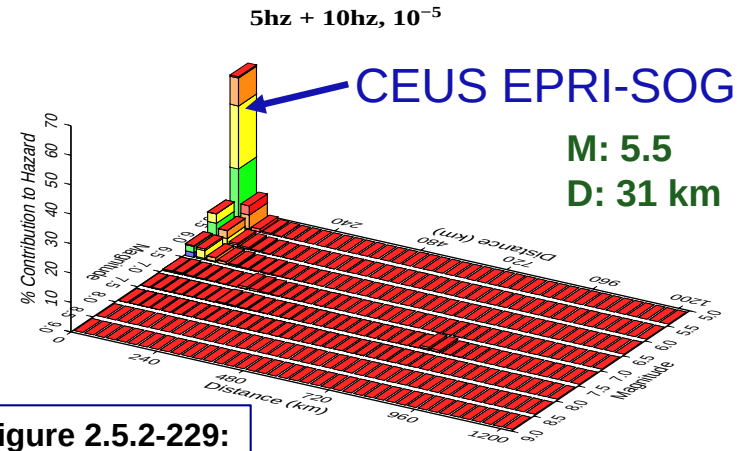
Figure 2.5.2-228: 1 & 2.5 Hz, 10^{-5}



M: 5.9
D: 110 km

D M

Figure 2.5.2-227: 5 & 10 Hz, 10^{-4}



CEUS EPRI-SOG

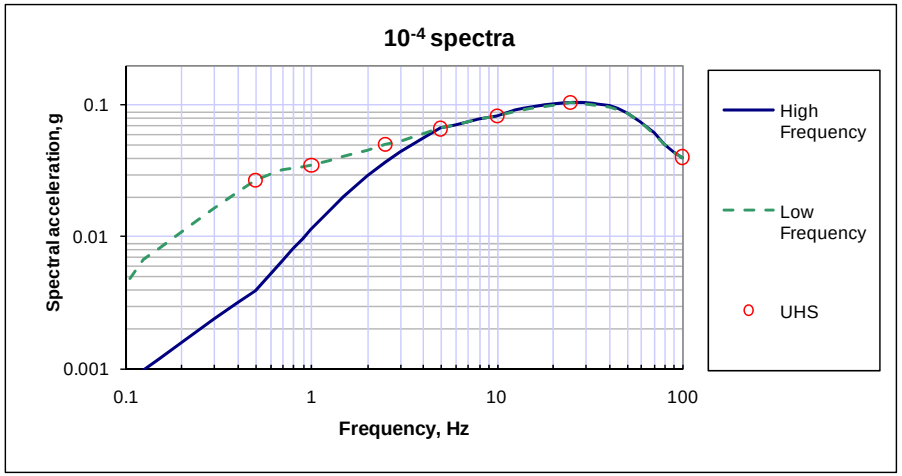
M: 5.5
D: 31 km

Figure 2.5.2-229: 5 & 10 Hz, 10^{-5}

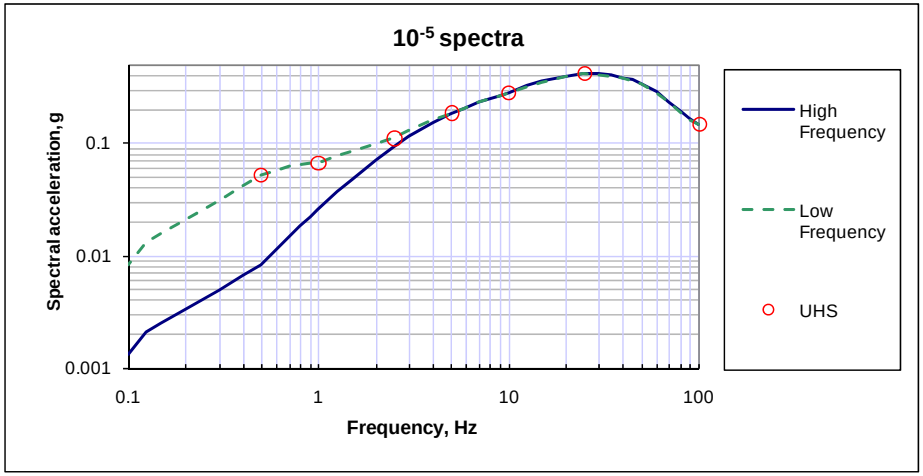
Turkey Point Nuclear Plant Units 6 & 7

Probabilistic Seismic Hazard Analysis

Hard Rock Input Ground Motions to Site Response Analysis



FSAR Figure 2.5.2-232 HF and LF Rock Spectra Anchored to Mean UHRS Values from Hazard Calculation for 10^{-4} Spectra



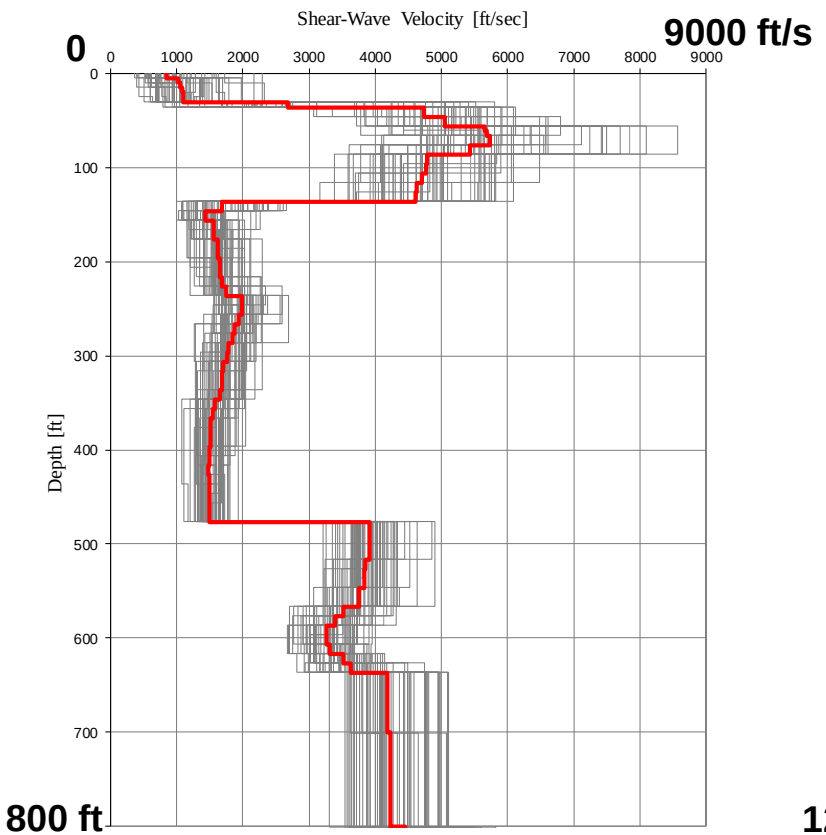
FSAR Figure 2.5.2-233 HF and LF Rock Spectra Anchored to Mean UHRS Values from Hazard Calculation for 10^{-5} Spectra

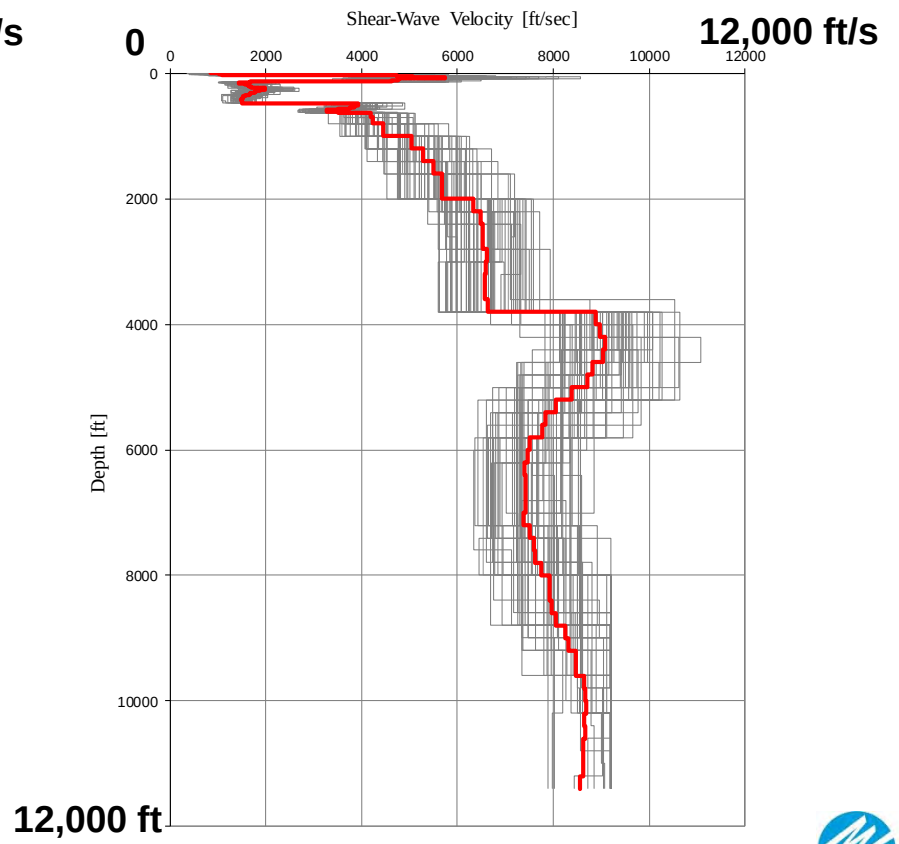
Reg. Guide 1.208: GMRS is determined from site-specific evaluations of ground motions associated with mean hazards of 10^{-4} and 10^{-5}.

Turkey Point Nuclear Plant Units 6 & 7

Randomized Shear-Wave Velocity Profiles

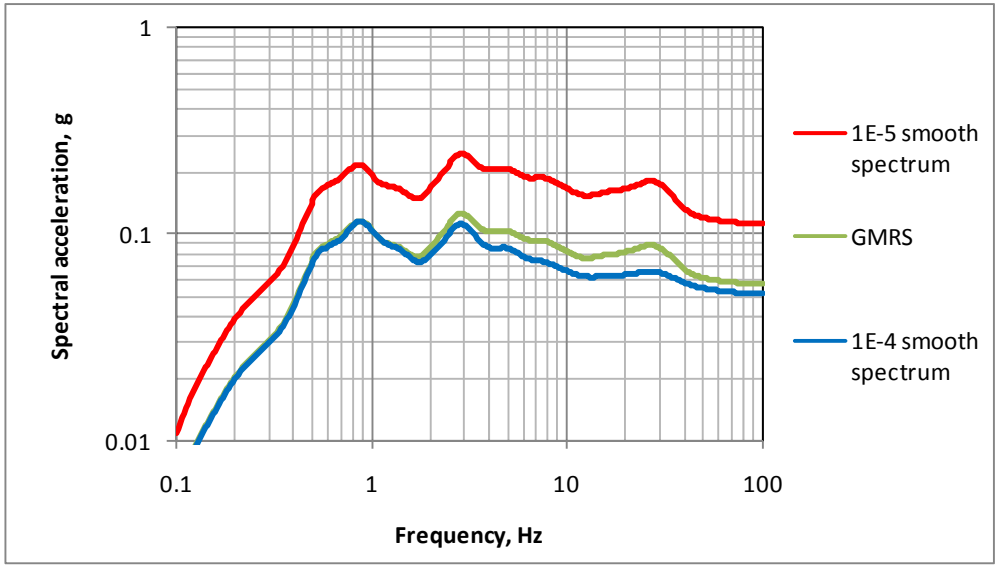
- 60 randomized profiles simulating in-situ soil conditions
- GMRS at El. -35 ft (depth of 60.5 ft) in Key Largo formation

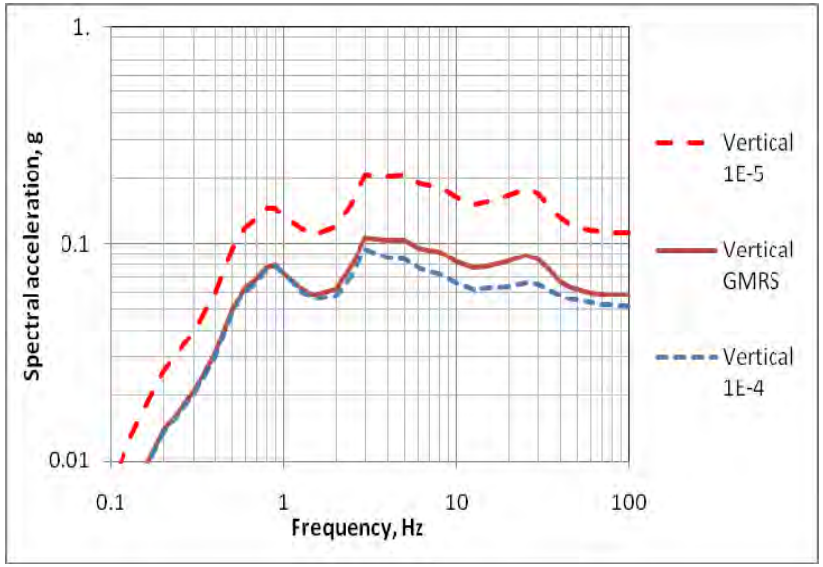




Turkey Point Nuclear Plant Units 6 & 7

Ground Motion Response Spectra





V/H: Reg. Guide 1.60

FSAR Figure 2.5.2-253 Smoothed Horizontal 1E-04 and 1E-05 Site Spectra and GMRS

FSAR Figure 2.5.2-254 Smoothed Vertical 1E-04 and 1E-05 Site Spectra and GMRS

Reg. Guide 1.208: Determination of the GMRS

$A_R = SA(10^{-5})/SA(10^{-4})$ Equation 2.5.2-14

$DF = 0.6 \times A_R^{0.8}$ Equation 2.5.2-15

$GMRS = max[SA(10^{-4}) \times max(1.0, DF), 0.45 \times SA(10^{-5})]$ Equation 2.5.2-16

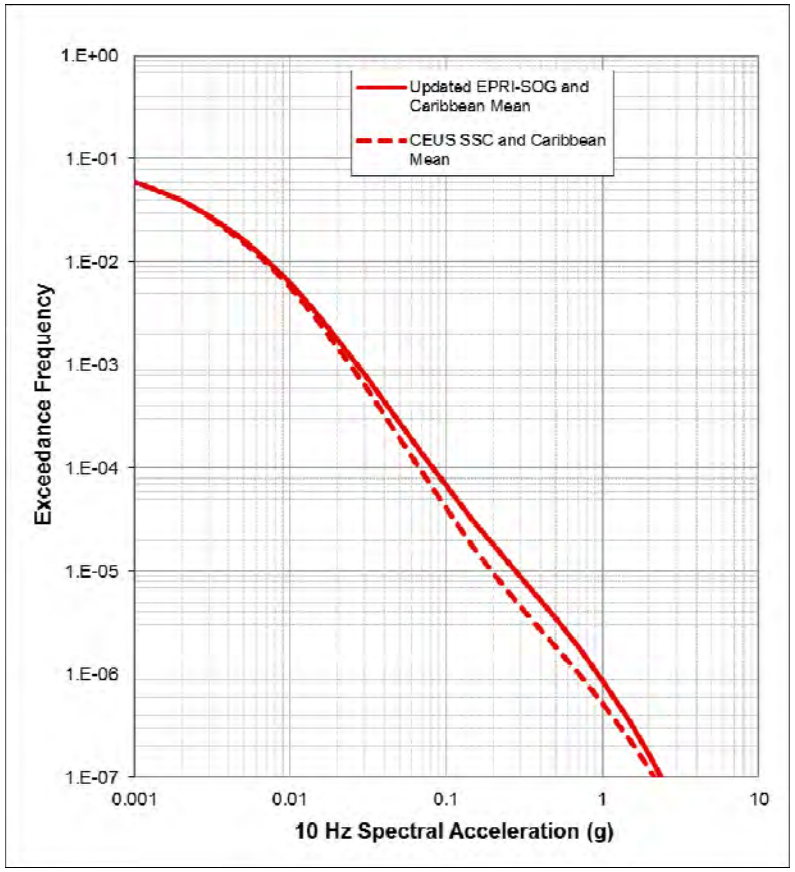
Comparison of PSHA Using Updated EPRI-SOG (1980's) SSC with EPRI et al. (2012) CEUS SSC

- **Following FSAR PSHA and GMRS development, a newer CEUS SSC model was published by EPRI et al. (2012)**
- **Cuba and Caribbean hazard added to PSHA using new CEUS SSC model to make comparison with FSAR total hazard**
- **The comparison shows:**
  - **2.5 Hz and higher:** Hazard from new CEUS SSC model lower
  - **1 Hz and lower:** Hazard from new CEUS SSC model is slightly higher

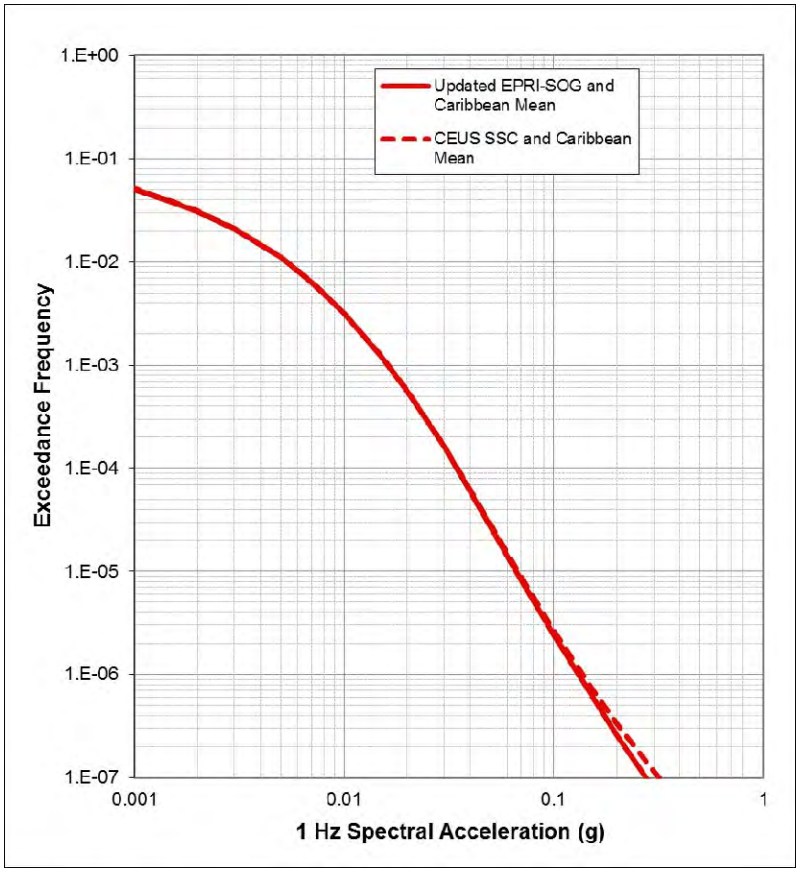
Turkey Point Nuclear Plant Units 6 & 7

CEUS SSC Sensitivity Analysis

Comparison of Hard Rock Hazard Results



FSAR Figure 2.5.2-283 Contributions of Various Source Types to Hard Rock Hazard for 10 Hz (modified)



FSAR Figure 2.5.2-284 Contributions of Various Source Types to Hard Rock Hazard for 1 Hz (modified)

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- Section 2.5 Geology, Seismology, and Geotechnical Engineering
- **Chap. 3 Design Of Structures, Components, Equipment and Systems**
- Section 13.3 Emergency Planning
- Chap. 19 Probabilistic Risk Assessment
- Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations
- Chap. 21 Design Changes Proposed in Accordance with ISG-11

Turkey Point Nuclear Plant Units 6 & 7

Chap. 3 - Design Of Structures, Components, Equipment and Systems

Paul Jacobs
Engineering Supervisor
New Nuclear Projects

Chapter 3 Summary

- AP1000 DCD Incorporated by Reference
- Standard Material Incorporated (including Supplements and Departures)
- External Missile Evaluations
- Foundation Input Response Spectra (FIRS)
- Soil Structure Interaction Analysis

Hurricane Missiles - Code Requirements & Provisions

- General Design Criterion (GDC) 1, "Quality Standards and Records" requires, in part, that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed
- GDC 2, "Design Basis for Protection against Natural Phenomena" requires structures, systems, and components that are important to safety be designed to withstand the effects of natural phenomena, such as hurricanes, without loss of the ability to perform their safety functions
- GDC 4, "Environmental and Dynamic Effects Design Basis" requires, in part, that structures, systems and components that are important to safety be adequately protected against the effects of missiles resulting from events and conditions outside the plant

Hurricane Missiles - Code Requirements & Provisions

- **RG 1.142, "Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Containments)"**
- **RG 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Rev. 1 decreased design basis tornado wind speeds, and tornado is no longer bounding for all areas of the U.S. for horizontal missiles**
- **RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants" (2011)**
  - Hurricane missile spectrum:
    - -- A massive high-kinetic-energy missile that deforms on impact (automobile)
    - -- A rigid missile that tests penetration resistance (pipe)
    - -- A small rigid missile of a size sufficient to pass through any opening in protective barriers (solid steel sphere)
  - Missiles are capable of striking in all directions
  - The barrier design should be evaluated using normal impact to the surface
  - All external missiles for hurricane are enveloped by the tornado missiles in the vertical direction, but not in the horizontal direction

Hurricane Missiles - Code Requirements & Provisions

AP1000 Design Tornado Missiles

Missile	Description	Weight #	Vh mph	Vv mph
1	Auto	4000	105	74
2	Armor Piercing Artillery Shell	275	105	74
3	Solid Steel Sphere	0.147	105	105

Turkey Point Unit 6 & 7 Hurricane Missiles

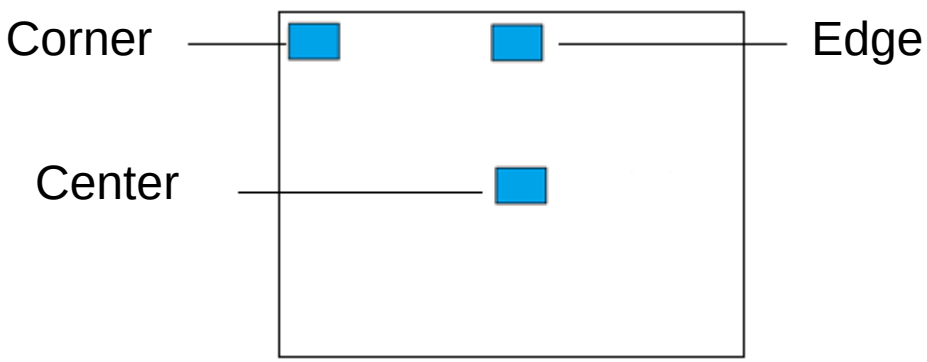
Missile	Description	Weight #	Vh mph	Vv mph
1	Auto	4000	180	58
2	Schedule 40 pipe	287	144.5	58
3	Solid Steel Sphere	0.147	128.5	58

Hurricane Missiles - Code Requirements & Provisions

- **ACI 349-01 Appendix C – Special Provisions for Impulsive and Impactive Effects**
  - C.1.4: Impactive loading may be defined in terms of time-dependent force or pressure
    - The AP1000 plant uses a time-dependent force function for the automobile missile
  - Energy balance techniques as prescribed in C.6.2 are used for pipe and sphere missiles
  - In accordance with ACI code, allowable ductility factor (μ) of 10 for flexure and 1.3 for shear are used

Automobile Missile Impact Evaluation

- **Center impact**
  - Both one-way and two-way shear are evaluated
  - Wind load and automobile missile load are considered
  - Dynamic Increase Factors (DIF) are used when applicable
- **Edge and corner impact**
  - Edge and corner effects are studied with dynamic analysis using the finite element code ABAQUS and the AP1000 plant NI05 model



Automobile Missile Impact Evaluation

- A dynamic time history analysis is performed using a single degree of freedom system. Flexure and shear strengths are evaluated to ACI 349-01
- Nonlinear finite element analyses are performed to investigate shear behavior
- Impacts were evaluated at center, edge and corner of critical walls
- Critical walls of the Auxiliary Building are selected based on thickness, reinforcement, location, span distance from the floor, and wall supports associated with the critical wall slab being evaluated
- Finite element analyses were performed to further investigate shear behavior. It is shown that out-of-plane shear behavior remains essentially linear elastic.

Hurricane Missiles - Conclusion

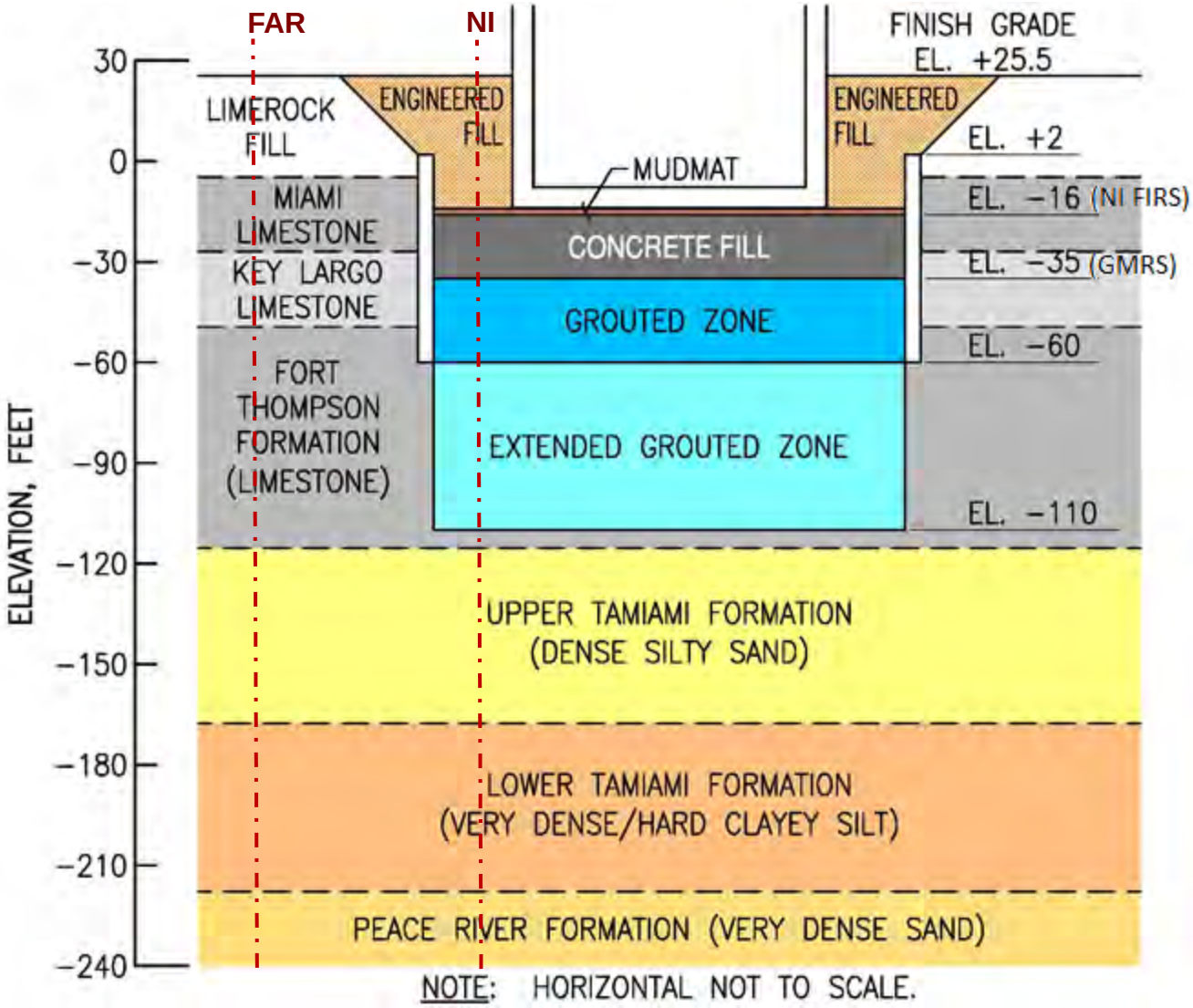
- The three hurricane missiles (automobile, pipe & sphere) were evaluated for horizontal impact on concrete walls
- The automobile missile was evaluated for impact at center, edge and corner of the critical walls

The certified design of the AP1000 concrete walls is acceptable for site-specific hurricane missile impacts at the Turkey Point site.

Turkey Point Nuclear Plant Units 6 & 7

Subsection 3.7.1.1 – Design Response Spectra

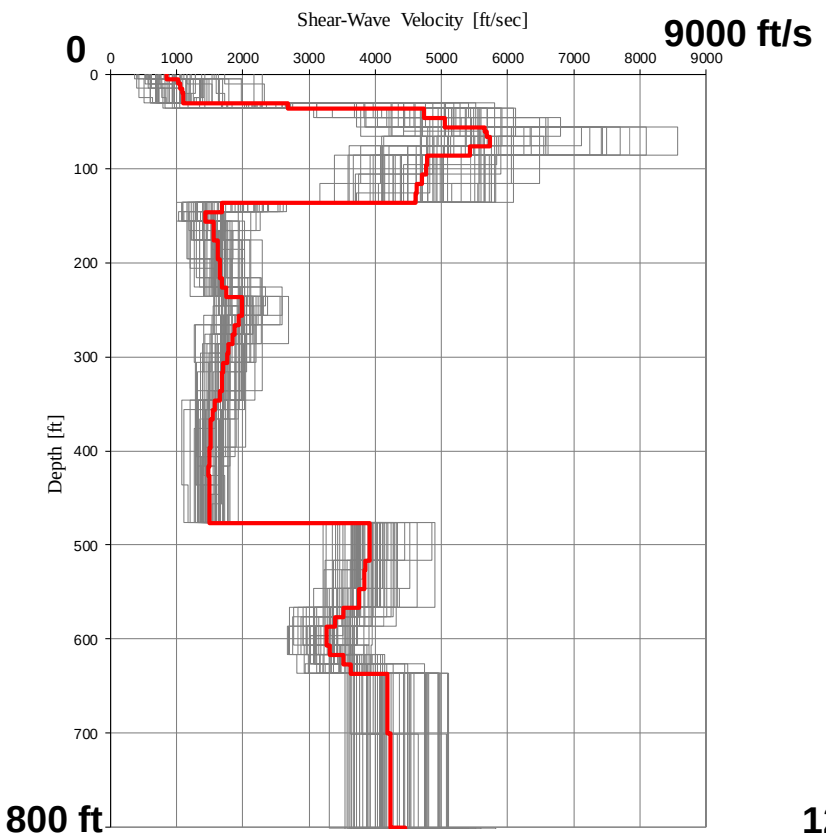
Considered Profiles (FAR and NI)

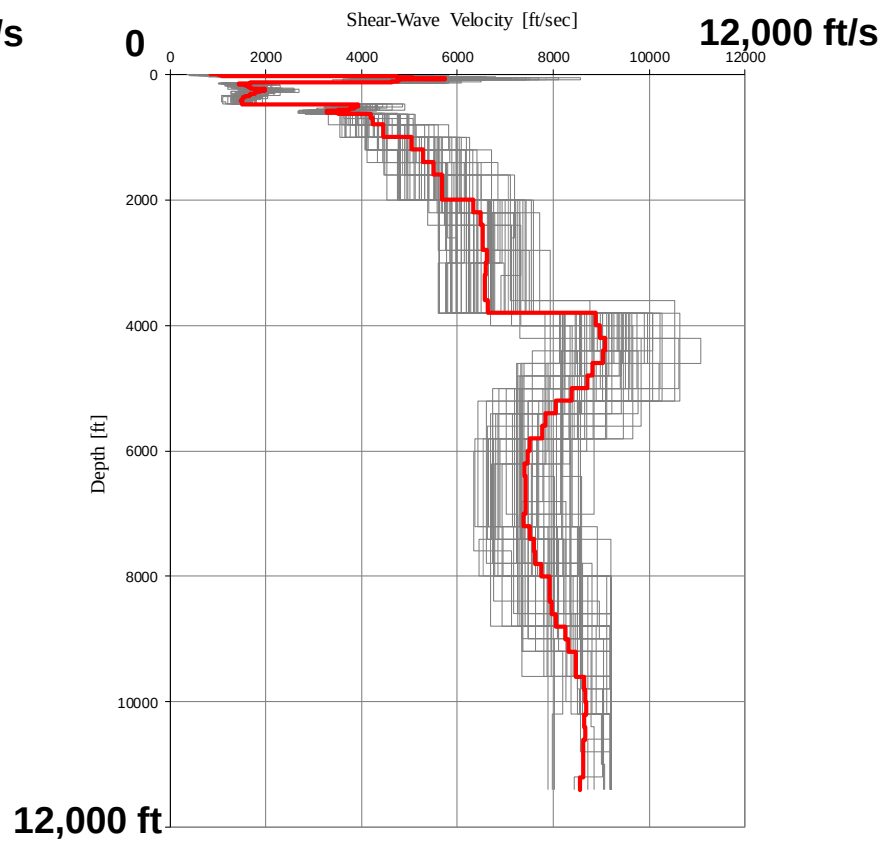


Turkey Point Nuclear Plant Units 6 & 7

Randomized Shear-Wave Velocity Profiles

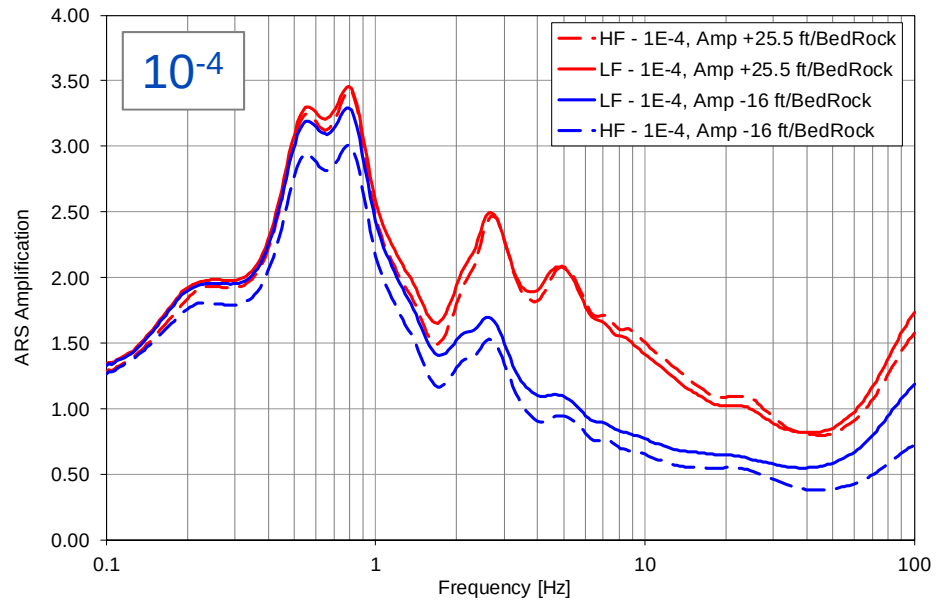
NI Profile: 60 randomized profiles simulating soil conditions at the Nuclear Island

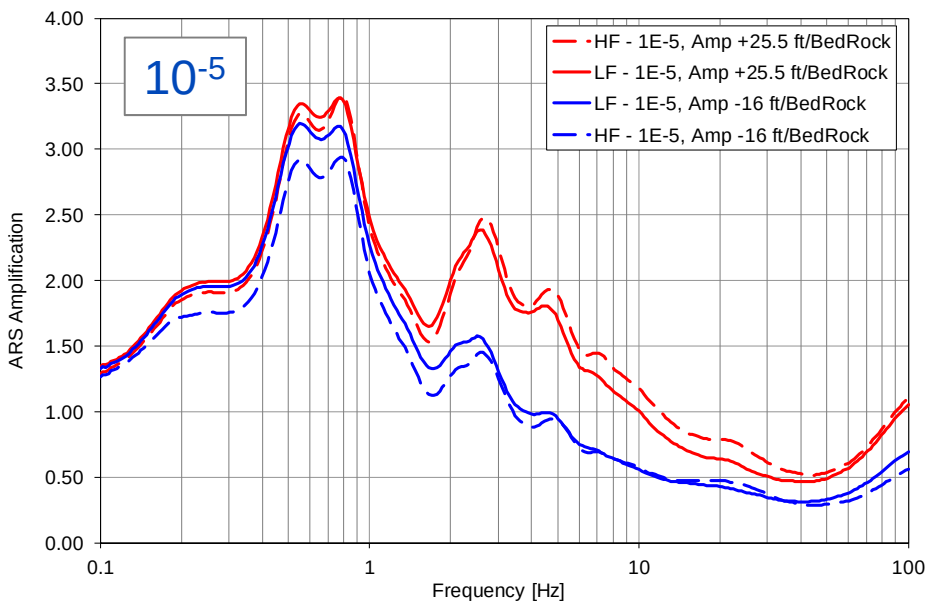




Turkey Point Nuclear Plant Units 6 & 7

Site Response Analysis Results (NI site conditions)





ARS amplification functions at:

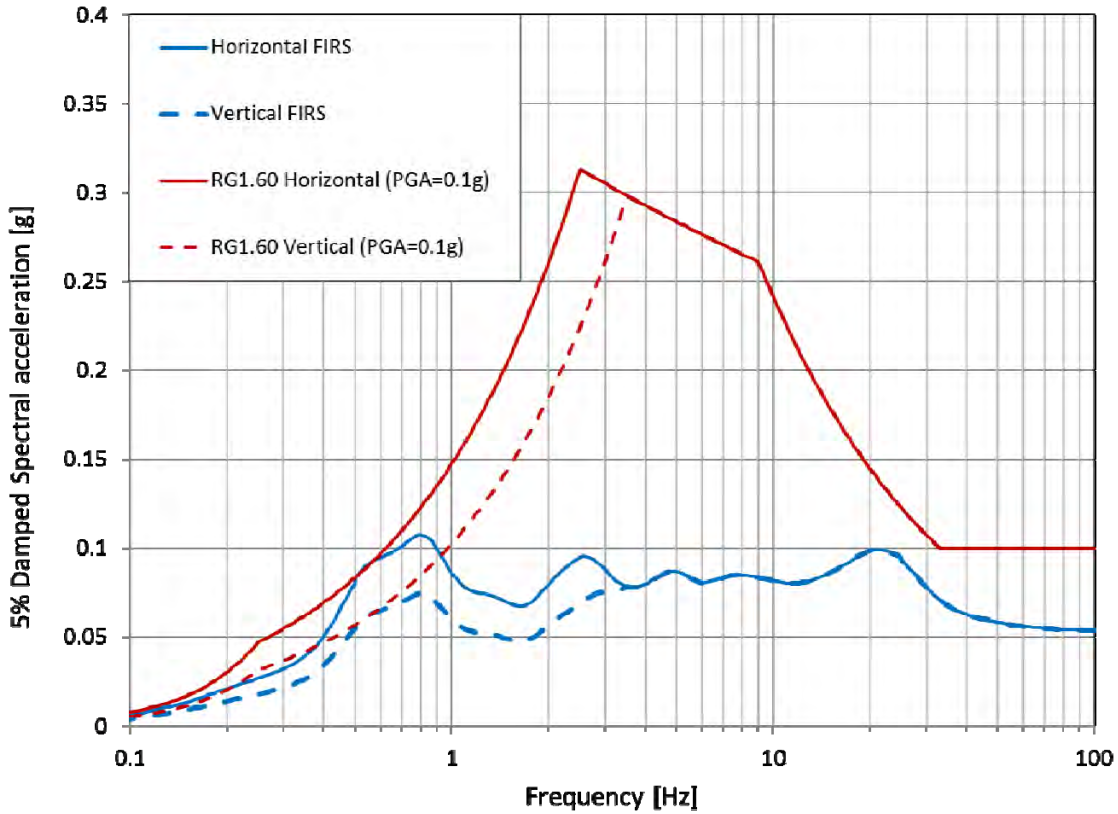
- Finish grade at El. +25.5 ft
- NI foundation at El. -16 ft

Turkey Point Nuclear Plant Units 6 & 7

FIRS and SSE

SSE is the envelope of:

- FIRS at NI foundation (Envelope of NI and FAR site conditions)
- RG 1.60 scaled to a PGA of 0.1g

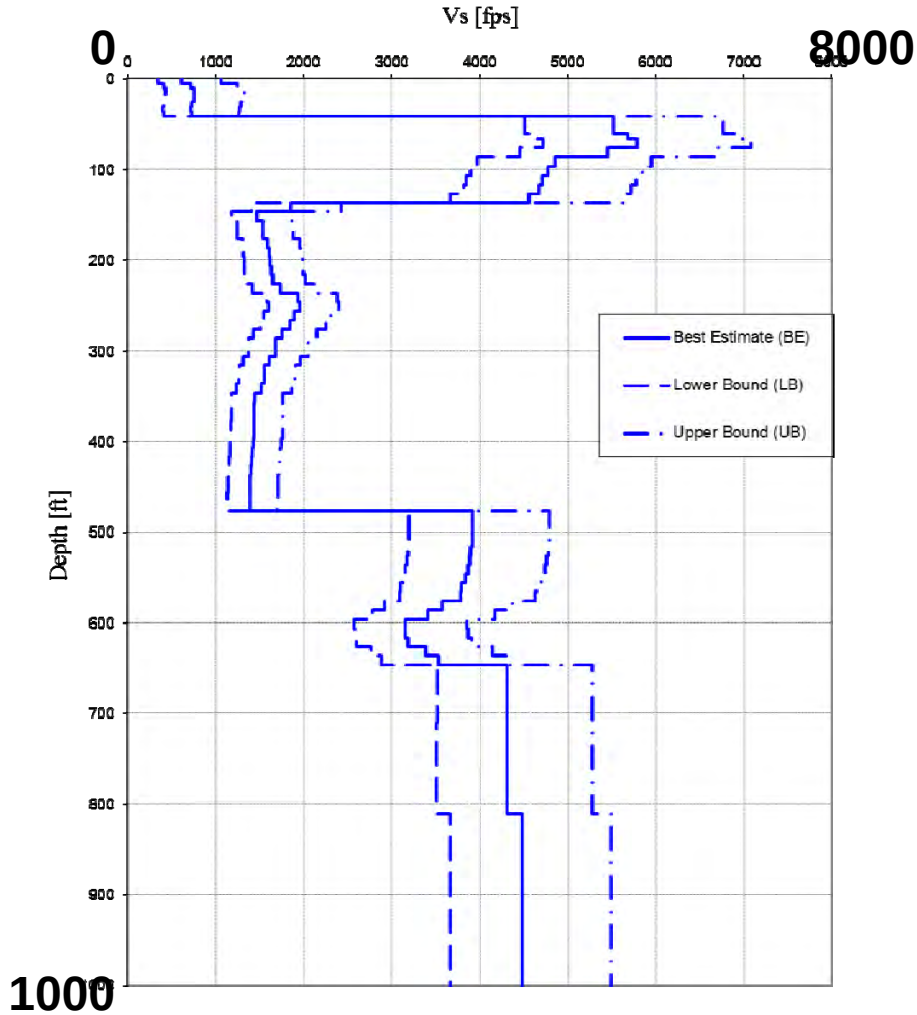


Adapted from FSAR Figure 3JJ-238

Selected SSE far exceeds site-specific motion

Turkey Point Nuclear Plant Units 6 & 7

SSI Profiles for NI Site Condition

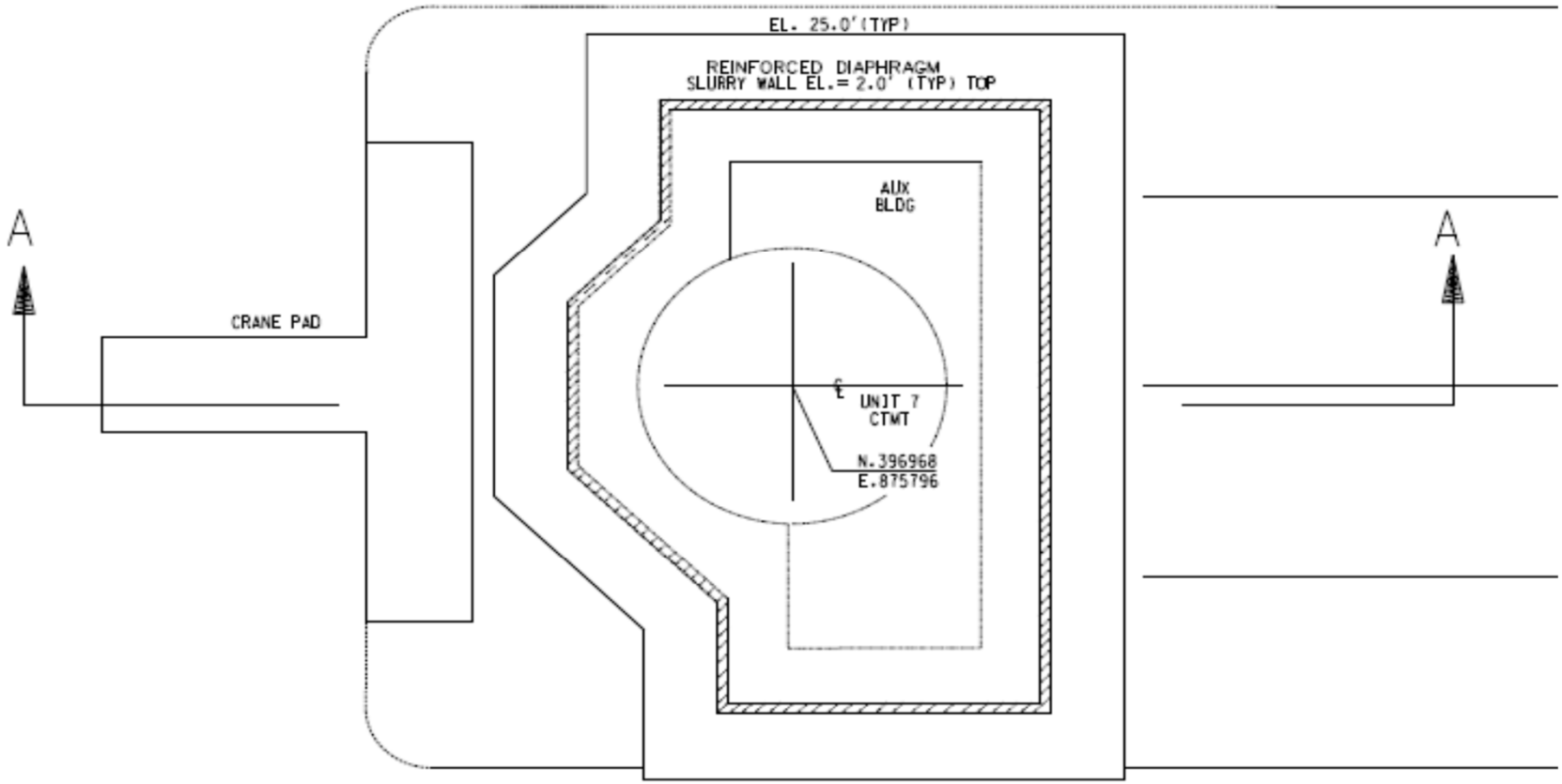


Turkey Point Seismic SSI Analyses Summary

- **Westinghouse has been performing soil structure interaction (SSI) analyses of the Florida Power & Light Company (FPL) Turkey Point Units 6 & 7 (PTN 6&7) Nuclear Island (NI) since 2009**
- **The SSI analyses have evaluated the effects of:**
  - FEM mesh size and its adequacy
  - The lean concrete fill
  - Variations of soil properties
  - Adjacent structures

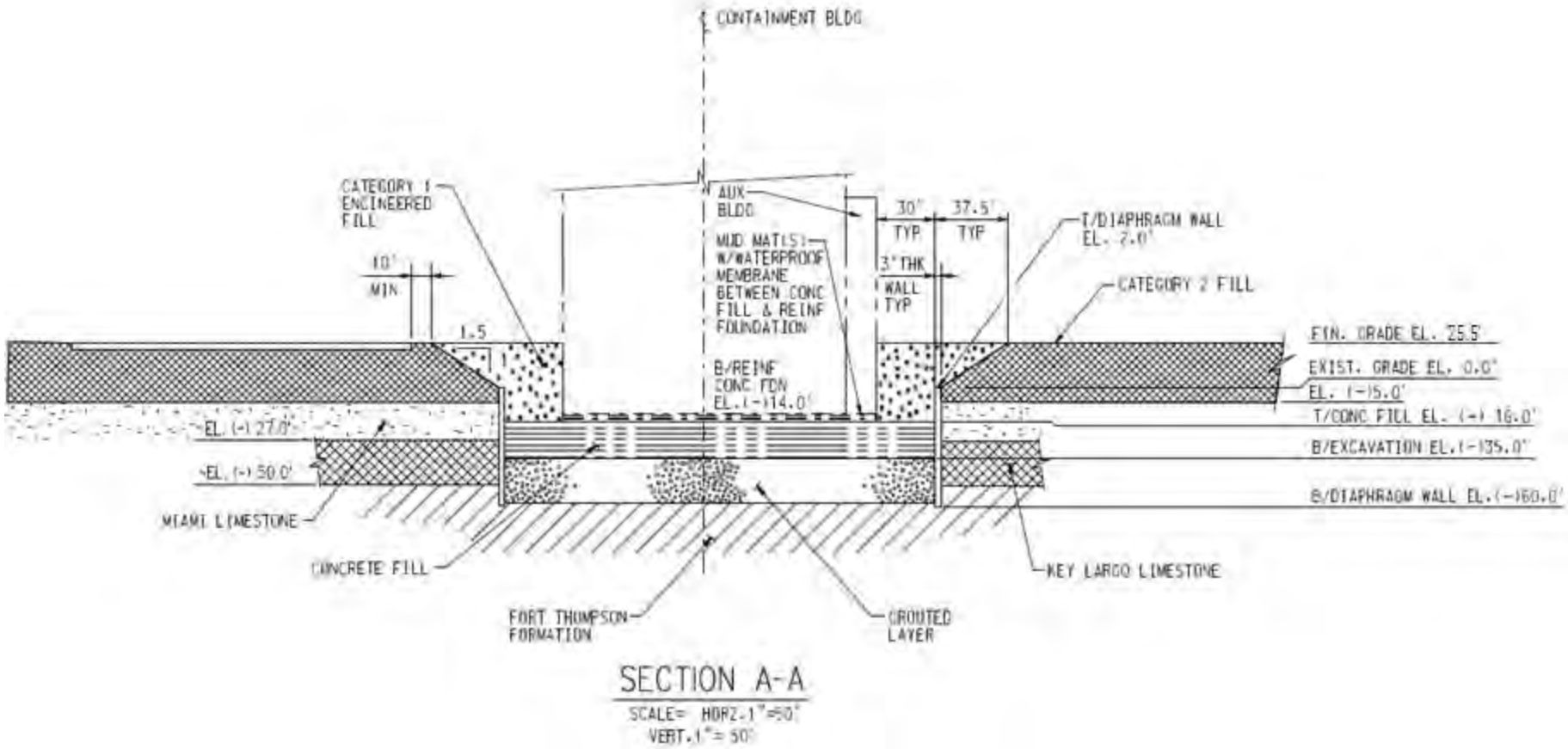
Turkey Point Nuclear Plant Units 6 & 7

Turkey Point Nuclear Plant Unit 7 Excavation Limits Plan



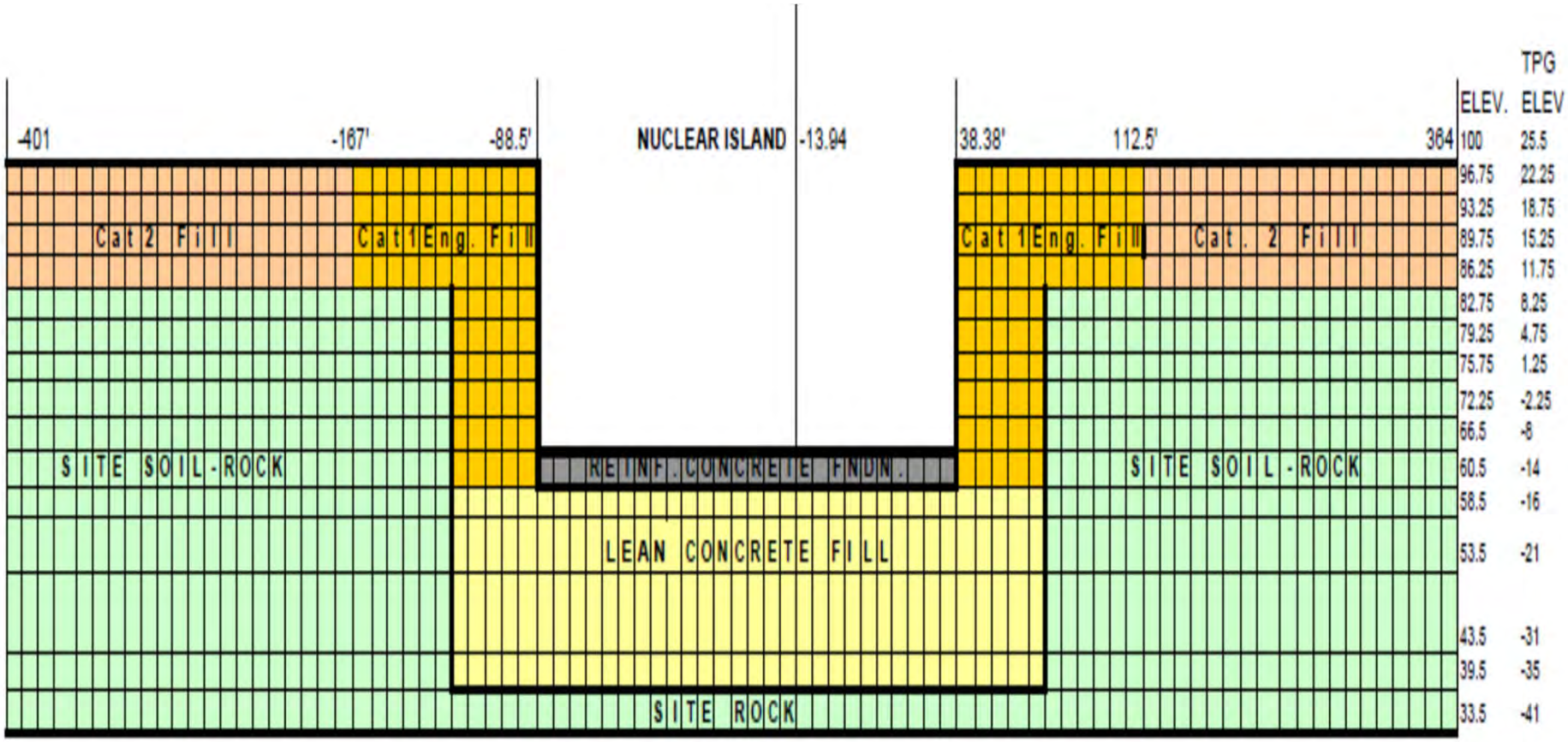
Turkey Point Nuclear Plant Units 6 & 7

Turkey Point Nuclear Plant Unit 7 Excavation Cross-Section



Turkey Point Nuclear Plant Units 6 & 7

Turkey Point Nuclear Plant 2D Fine SASSI Model (not to scale)



Seismic SSI Analyses Summary Conclusions

- **The PTN 6&7 site-specific design-basis SSI analyses have incorporated multiple levels of conservatism to address potential seismic input, material parameter and analytical uncertainties including:**
  - RG 1.60 and PTN 6&7 site-specific FIRS
  - BE and LB to UB ranges of soil, rock, concrete, and grouted rock strain compatible shear wave, compression wave, damping and unit weight properties
  - 2D – 3D model mesh size and passing frequency bump factors
  - Enveloped BE, LB and UB SSI ISRS
  - Broadening (±15 percent) of the ISRS envelope

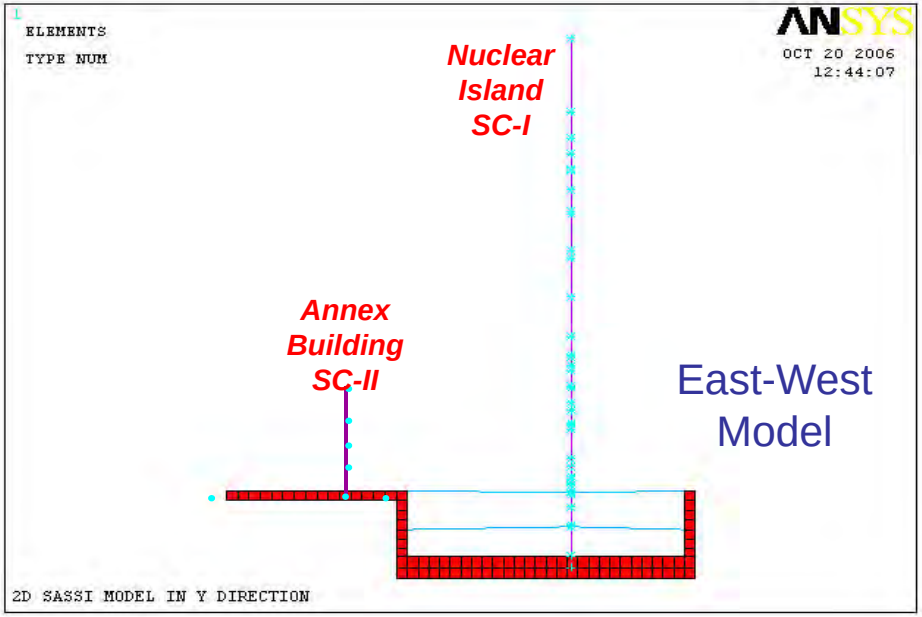
Design-Basis BE, LB and UB Seismic SSI Analyses Summary

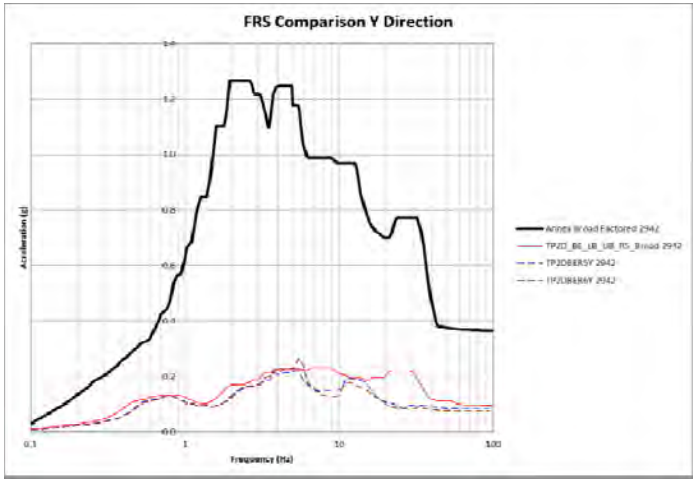
- The nuclear island (NI) and adjacent structures SSI analyses utilized an envelope of RG 1.60 and PTN 6&7 site-specific FIRS anchored to minimum PGA = 0.1g for the NI, and incorporated the site-specific performance-based surface response spectra (PBSRS) for adjacent structures
- The updated SSI analyses incorporated hazard consistent, strain compatible BE, LB and UB soil, rock, concrete and grouted rock profiles in both NI and SCII adjacent structures evaluations
- Relative displacements of SCII structures indicated no seismic interaction between NI and Turbine Building 1st Bay and Annex Building
- The resulting NI and adjacent structures in-structure response spectra (ISRS) for all cases, i.e., BE, LB and UB were enveloped, broadened ±15 percent, which were compared to, and enveloped by the AP1000 CSDRS envelope spectra with appreciable margin

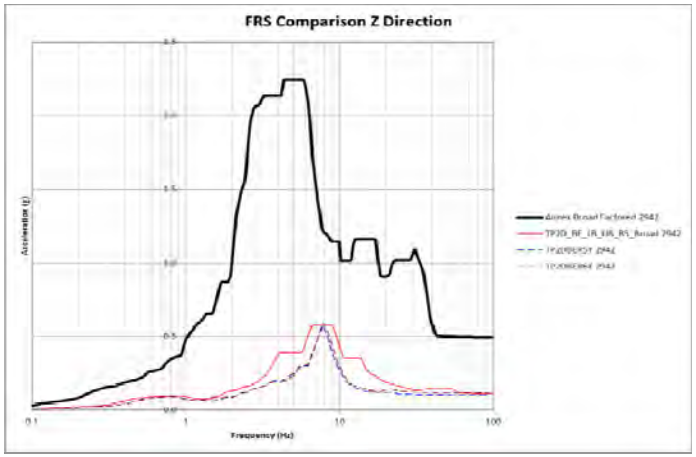
Turkey Point Nuclear Plant Units 6 & 7

Comparison of ISRS: CSDRS vs PTN 6&7 BE Sensitivity and Detailed Analysis

Annex Building Foundation (AP1000 El. 100 feet)



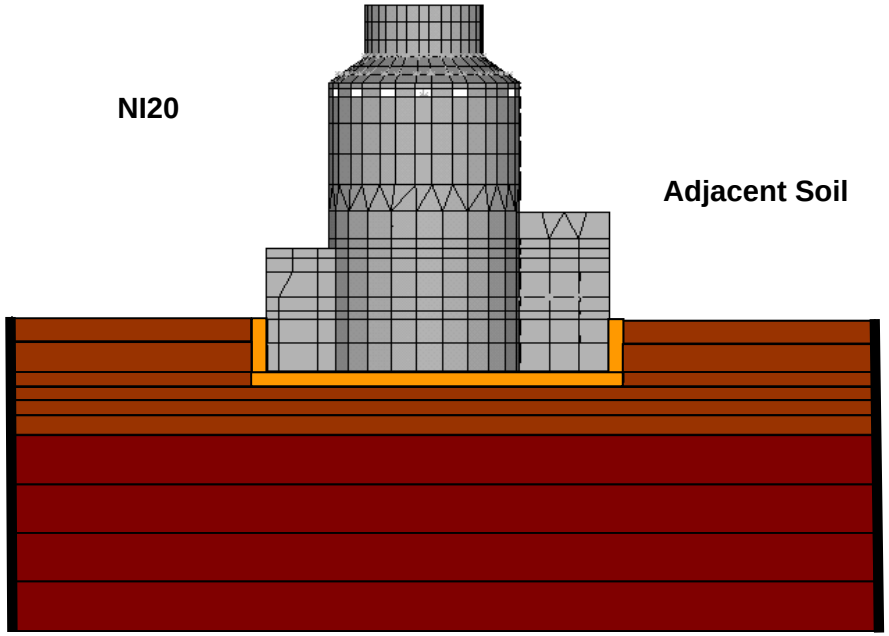




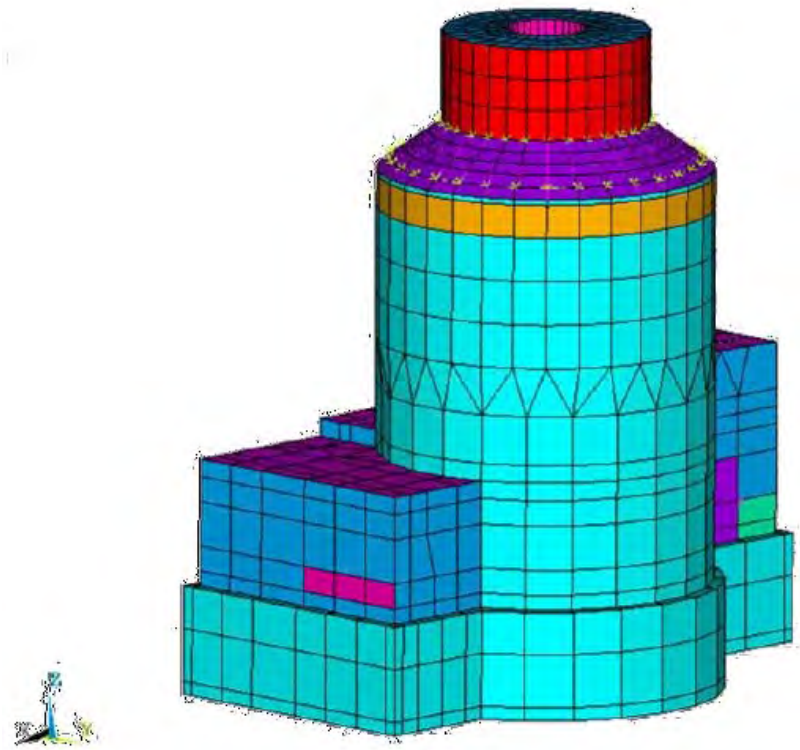
SCII (Appendix F) BE Seismic Sensitivity SSI Analyses Summary

- **The 2D NS and EW models were used to obtain updated BE sensitivity analyses relative displacements at the following locations:**
  - Turbine Building 1st Bay foundation to Nuclear Island
  - Top of Turbine Building 1st Bay to Nuclear Island
  - Annex Building foundation to Nuclear Island
  - Top of Annex Building to Nuclear Island
- **SCII adjacent structures SSI sensitivity analysis relative displacements were compared to the site-specific design-basis relative displacements**
- **To prevent contact, the relative displacements between the NI and the foundations and top of the adjacent structures must be less than 2 inches and 4 inches, respectively**

Seismic Design



SASSI Model Looking East

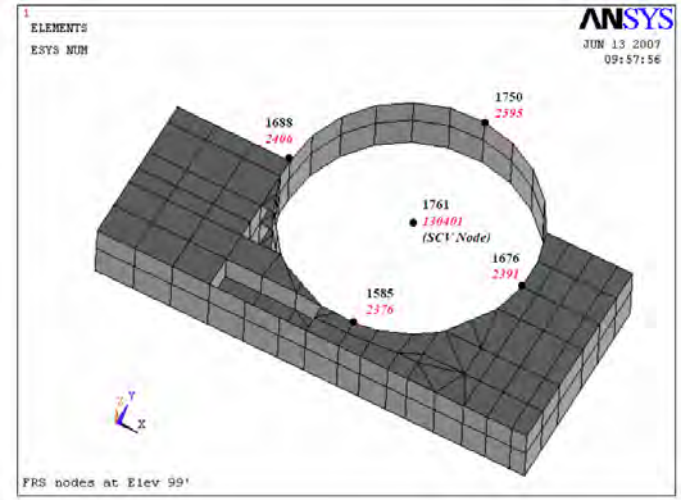


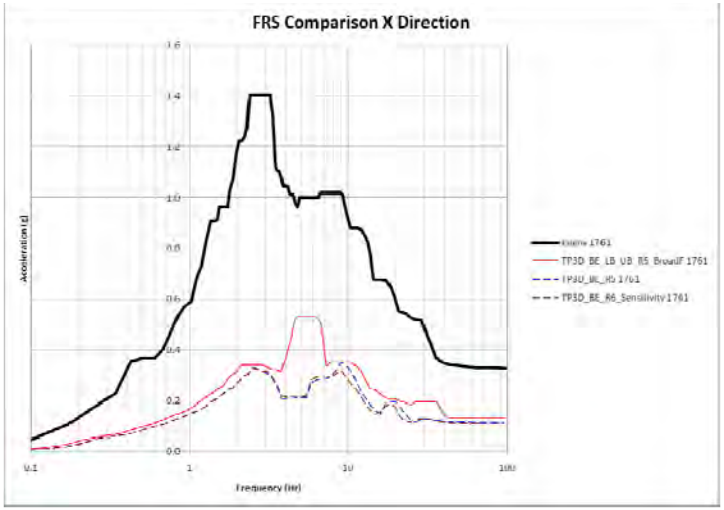
SASSI MODEL Isometric View

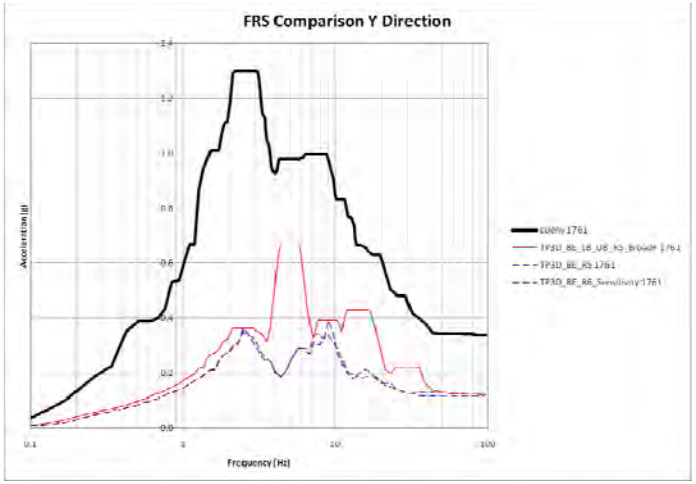
Turkey Point Nuclear Plant Units 6 & 7

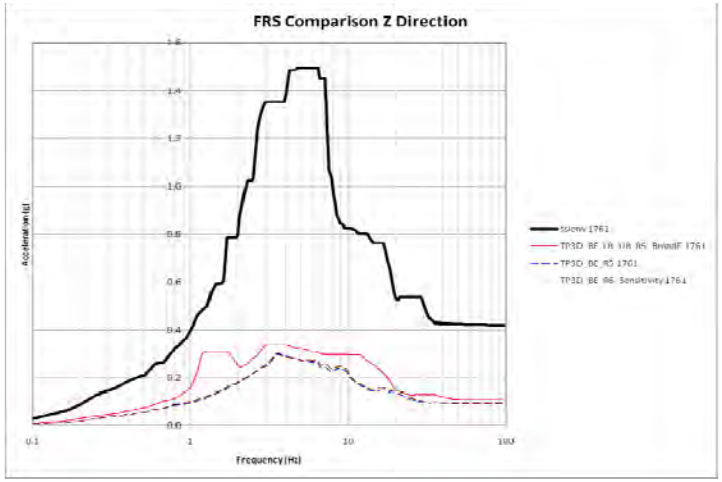
Comparison of ISRS: CSDRS vs PTN 6&7 BE Sensitivity and Detailed Analysis

Containment Internal Structures at Elevation 99'-0" of Reactor Vessel Support





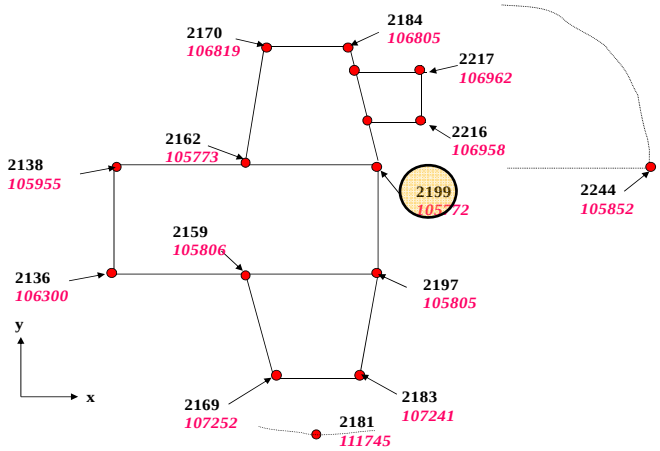


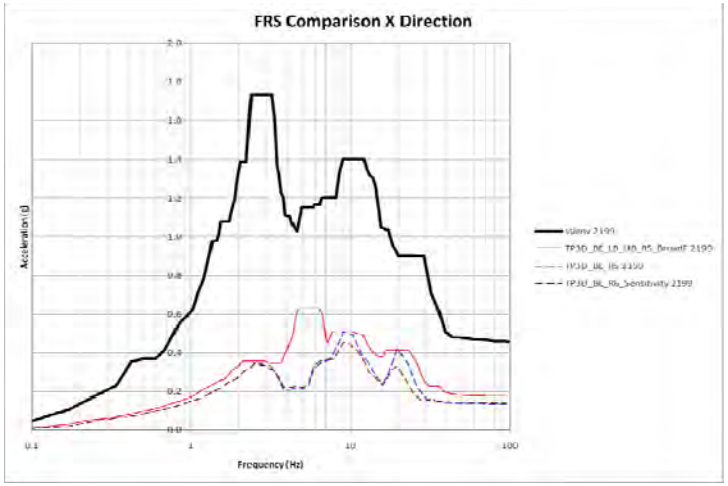


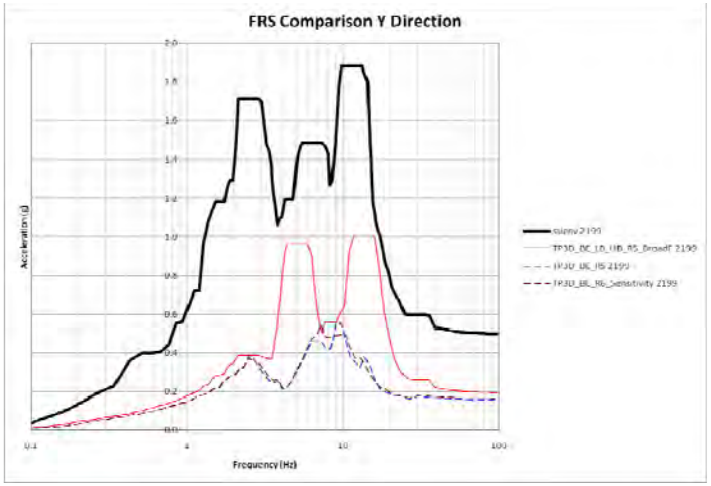
Turkey Point Nuclear Plant Units 6 & 7

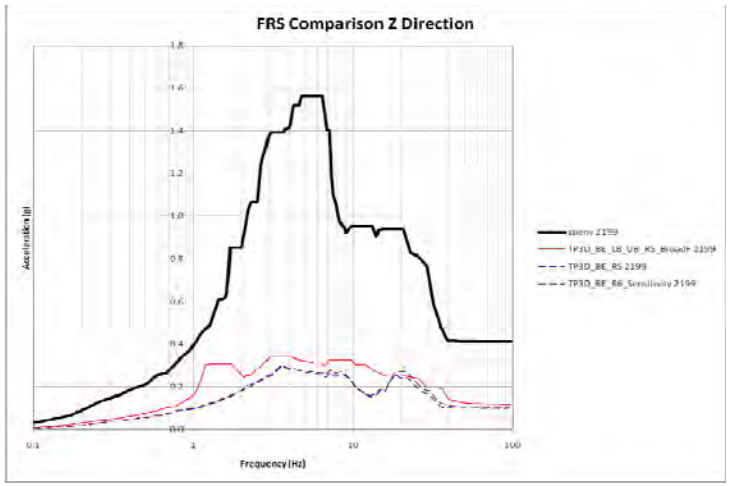
Comparison of ISRS: CSDRS vs PTN 6&7 BE Sensitivity and Detailed Analysis

Containment Operating Floor





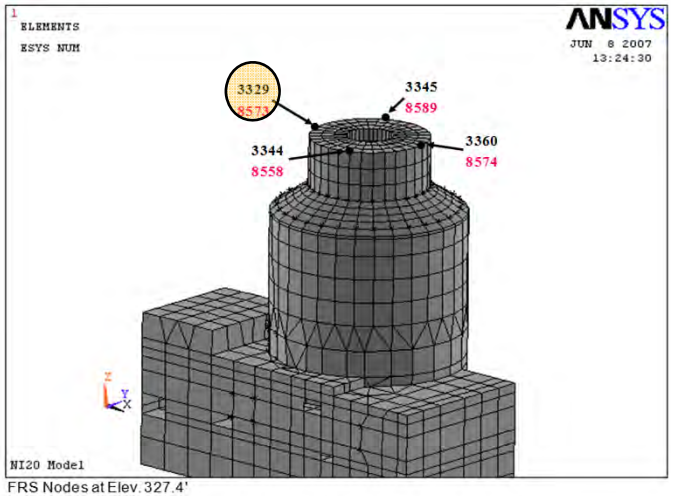




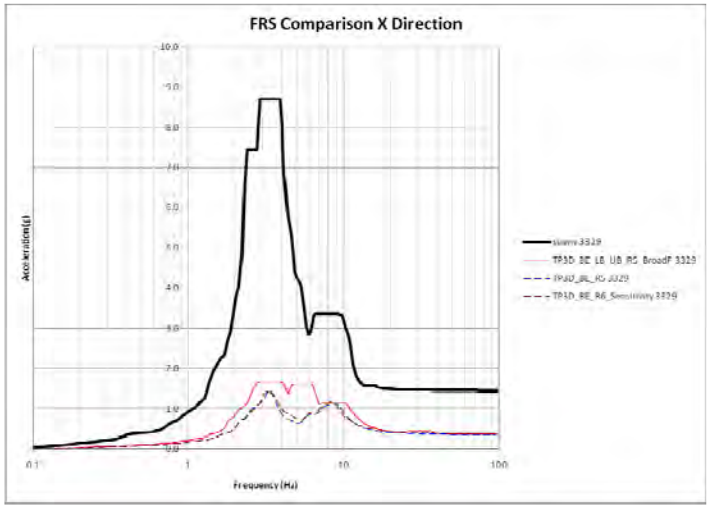
Turkey Point Nuclear Plant Units 6 & 7

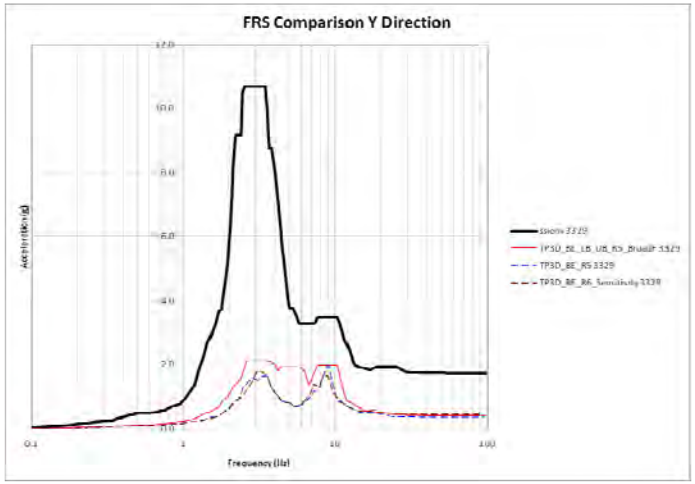
Comparison of ISRS: CSDRS vs PTN 6&7 BE Sensitivity and Detailed Analysis

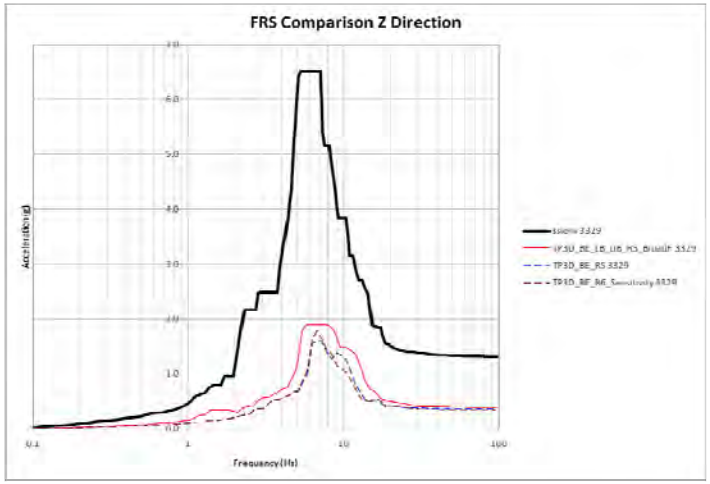
Shield Building Roof Elevation 327'



FRS Nodes at Elev. 327.4'







Final Seismic SSI Analyses Conclusions

- **The PTN 6&7 site-specific SSI analyses have incorporated multiple levels of conservatism and sensitivity analyses to address potential seismic input, material parameter and analytical uncertainties including:**
  - RG 1.60 and PTN 6&7 site-specific FIRS
  - 2D – 3D model mesh size and passing frequency bump factors
  - Validation of ISRS and transfer functions due to variations in Poisson's Ratio
  - Broadening (±15 percent) of the ISRS envelope
- **The PTN 6&7 site-specific ISRS are enveloped by the AP1000 design spectra envelope with margin at the key NI and SCII adjacent structure locations**

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- Section 2.5 Geology, Seismology, and Geotechnical Engineering
- Chap. 3 Design Of Structures, Components, Equipment and Systems
- **Section 13.3 Emergency Planning**
- Chap. 19 Probabilistic Risk Assessment
- Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations
- Chap. 21 Design Changes Proposed in Accordance with ISG-11

Turkey Point Nuclear Plant Units 6 & 7

Section 13.3 Emergency Planning

Steve Franzone
Licensing Manager
New Nuclear Projects

Emergency Plan Summary

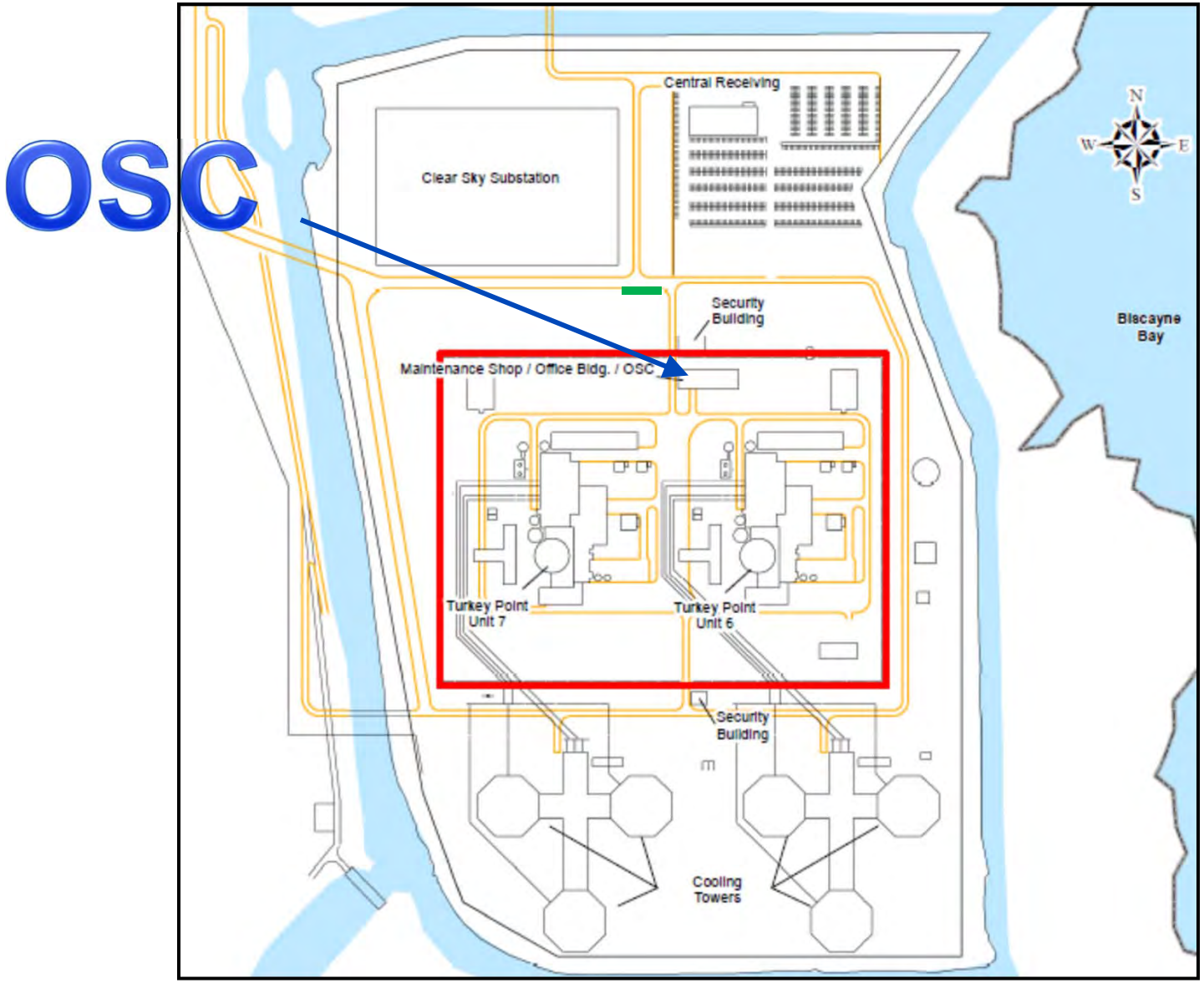
- **Single Emergency Plan for all four (4) Turkey Point Site Units**
  - Follows NUREG-0654 format
    - -- Addresses the sixteen planning standards & associated evaluation criteria
    - -- Part 1 provides introductory information
    - -- Part 2 provides generic information applicable to all the units
    - -- 3 Annexes describe unit specific information
      - – Annex 1 applies to existing Units 3 & 4
      - – Annex 2 applies to new Unit 6 single unit operation
      - – Annex 3 applies to Unit 6 & 7 operation
  - Developed in accordance with:
    - -- NUREG-0654/FEMA-REP-1 Rev 1
    - -- 10 CFR 50.47
    - -- 10 CFR 50 Appendix E

Turkey Point Nuclear Plant Units 6 & 7

Emergency Plan Facilities

Turkey Point Nuclear Plant Units 6 & 7

Emergency Plan Facilities

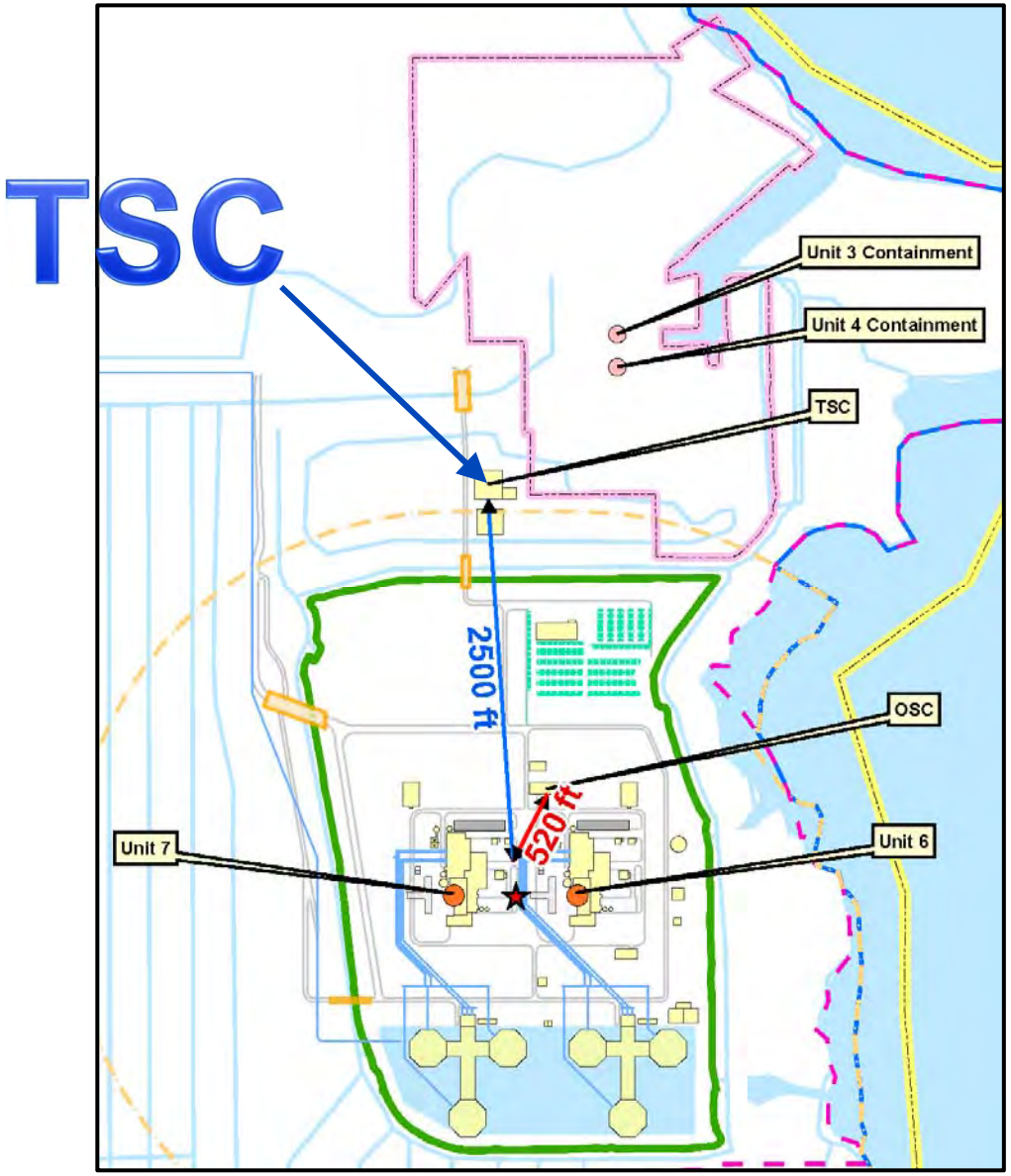


Operations Support Center (OSC)

- **The Units 6 & 7 Protected Area has a dedicated OSC located in the Maintenance Support Building**
- **Identified by DCD Departure PTN DEP 18.8-1**
- **The use of a common OSC for a Protected Area is consistent with existing FPL Plants**
  - St. Lucie Units 1 & 2
    - -- Separate Control Rooms for each unit
    - -- Common TSC for the Site located inside Unit 1 Auxiliary Building
    - -- Common OSC located in the Maintenance Support Building
  - Existing Turkey Point Units 3 & 4
    - -- Single Control Room for both Units
    - -- Common TSC for both units located inside the PA
    - -- Common OSC for both units located in the Maintenance Support Building

Turkey Point Nuclear Plant Units 6 & 7

Emergency Plan Facilities



Technical Support Center (TSC)

- **Common for all 4 Turkey Point Site Units**
  - Located in the New Turkey Point Nuclear Training Building.
    - -- Identified by DCD Departure PTN DEP 18.8-2
    - -- This location provides the ability to respond and activate the facility in a timely fashion independent of the unit(s) that may be affected by the emergency
    - -- It also will permit the use of the TSC in a security event that may curtail the entry of ERO personnel into a Protected Area of the affected unit(s)
  - The TSC meets the guidance of NUREG-0696, *Functional Criteria for Emergency Response Facilities* and RG 1.206, *Combined License Applications for Nuclear Power Plants*
    - -- regarding structure, habitability, size, communications, instrumentation, data system equipment, power supplies, technical data, records availability, and management

Technical Support Center (TSC)

- **Common for all 4 Turkey Point Site Units**
  - The TSC does not meet the guidance of NUREG-0696, *Functional Criteria for Emergency Response Facilities,* regarding location of the TSC
    - -- The location of the TSC is outside of the Protected Areas between the Control Room for Units 3 & 4 and the Control Rooms for Units 6 & 7
    - -- The separation of the TSC from any of the 3 control rooms is approximately 2500 ft. with travel time of 10-15 minutes and includes processing time through the Protected Area Security Control Points
    - -- Although the TSC does not provide capability for face-to-face communications or being within 2 minutes of the affected Control Room(s), it is provided with communication links that can transmit and receive direct voice and data communications from the affected Control Room, TSC, OSC, and the EOF
  - Use of current technologies such as updated computer equipment, teleconferencing, real time system monitoring of plant data, and telephone and radio systems for primary and emergency communications will bridge the physical separation
  - Similar to the TSC arrangement approved for V.C. Summer Units 2 & 3 COL

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- Section 2.5 Geology, Seismology, and Geotechnical Engineering
- Chap. 3 Design Of Structures, Components, Equipment and Systems
- Section 13.3 Emergency Planning
- **Chap. 19 Probabilistic Risk Assessment**
- Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations
- Chap. 21 Design Changes Proposed in Accordance with ISG-11

Turkey Point Nuclear Plant Units 6 & 7

Chap. 19 Probabilistic Risk Assessment

Steve Franzone
Licensing Manager
New Nuclear Projects

Chapter 19 Probabilistic Risk Assessment

- **AP1000 DCD Incorporated by Reference**
- **Standard Material Incorporated (including Supplements)**
- **Site-Specific Information**
  - Annual frequency of severe winds and tornados events exceeds 1.0E-07 events per year
  - Annual frequency of aviation accidents exceeds 1.0E-07 events per year

Section 19.58 – Winds, Floods, and Other External Events

- **Two Screening Criteria used to determine whether a detailed PRA is required:**
  - External event category screened out on the basis of its annual frequency (less than 1.0E-7/yr)
  - External event category screened out based on the annual core damage frequency (CDF) associated with that external event category—If CDF does not exceed 1.0E-8/yr, the external event category can be screened out
- **Annual frequency of aviation accidents presented in Section 2.2 exceeds 1.0E-7 per year**
  - Screening CDF is calculated for aviation accidents
  - The base case result (2.26E-13 events/year) is below the screening criterion of 1.0E-8/year and further detailed PRA is not required
- **Annual frequency of tornado and hurricane events presented in Section 2.3 exceeds 1.0E-7 per year (PTN DEP 19.58-1)**
  - Screening CDF is calculated for high winds
  - The base case analysis (1.0E-8 per year) demonstrates second criterion is met and further detailed PRA is not necessary

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- Section 2.5 Geology, Seismology, and Geotechnical Engineering
- Chap. 3 Design Of Structures, Components, Equipment and Systems
- Section 13.3 Emergency Planning
- Chap. 19 Probabilistic Risk Assessment
- **Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations**
- Chap. 21 Design Changes Proposed in Accordance with ISG-11

Turkey Point Nuclear Plant Units 6 & 7

Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations

Paul Jacobs
Engineering Supervisor
New Nuclear Projects

Fukushima NTTF Recommendations

- **NRC Fukushima Near-term Task Force (NTTF) Recommendations resulted in NRC RAI Letter No. 58, dated May 1, 2012, being issued for the Turkey Point Unit 6 & 7 COL application**
  - NTTF Recommendation 9.3, EP Staffing and Communications
  - NTTF Recommendation 4.2, Mitigating Strategies
  - NTTF Recommendation 7.1, SFP Instrumentation

Fukushima NTTF Recommendations

- **Recommendation 9.3 (EP)**
  - NRC Fukushima Near-term Task Force (NTTF) Recommendation 9.3 on EP staffing and communications resulted in NRC RAI Letter No. 58, RAI 1.05-4, dated May 1, 2012, being issued for the Turkey Point Unit 6 & 7 COL application
    - -- Turkey Point Units 6 & 7 responded to this RAI based on NTTF Recommendation 9.3 requirements
    - -- Turkey Point Units 6 & 7 has proposed a license condition to address the recommended staffing and communications assessments using NRC endorsed NEI 12-01, Rev 0, *Guidelines for Assessing Beyond Design Basis Accident Response Staffing and Communications Capabilities*

Fukushima NTTF Recommendations

- **Recommendation 4.2 (Mitigating Strategies)**
  - Fukushima NTTF Recommendation 4.2 on mitigating strategies resulted in NRC RAI Letter No. 58, RAI 1.05-2, dated May 1, 2012, being issued for the Turkey Point Unit 6 & 7 COL application
    - -- Turkey Point Units 6 & 7 responded to this RAI based on NTTF Recommendation 4.2 requirements
    - -- Turkey Point Units 6 & 7 has committed to a proposed license condition to address the recommended actions to address Mitigation of Beyond-Design-Basis Events (MBDBE) proposed rule (10 CFR 50.155) using the guidance described in NRC endorsed NEI 12-06, Rev 0, *Diverse and Flexible Coping Strategies (FLEX) Implementation* Guide, Appendix F, *Guidance for AP1000 Design*, and Westinghouse Report, APP-GW-GLR-171, *AP1000 Flex Integrated Plan*

Fukushima NTTF Recommendations

- **Recommendation 7.1 (Spent Fuel Pool Instrumentation)**
  - Fukushima NTTF Recommendation 7.1 on spent fuel pool (SFP) instrumentation resulted in NRC RAI Letter No. 58, RAI 1.05-3, dated May 1, 2012, being issued for the Turkey Point Unit 6 & 7 COL application
    - -- Turkey Point Units 6 & 7 responded to this RAI based on NTTF Recommendation 7.1 requirements
    - -- Turkey Point Units 6 & 7 has a proposed license condition to address the training portion of the actions required for this recommendation
    - -- NEI 12-02, Appendix A4, *AP1000 Spent Fuel Pool Instrumentation Guidance*, addresses how the other portions of the NTTF Recommendation 7.1 are satisfied by the AP1000 plant design
    - -- DCD Chapter 9 text was supplemented with additional information on SFP level instrumentation in Turkey Point Units 6 & 7 FSAR Chapter 9
    - -- Turkey Point Units 6 & 7 Departure (PTN DEP 3.11-1) was taken to correct an inconsistency in DCD Table 3.11-1, Sheet 14 of 51 relative to SFP level instrument "Envir. Zone" number

Turkey Point Nuclear Plant Units 6 & 7
Day 2

- Section 2.5 Geology, Seismology, and Geotechnical Engineering
- Chap. 3 Design Of Structures, Components, Equipment and Systems
- Section 13.3 Emergency Planning
- Chap. 19 Probabilistic Risk Assessment
- Chap. 20 Requirements Resulting from Fukushima Near-Term Task Force Recommendations
- **Chap. 21 Design Changes Proposed in Accordance with ISG-11**

Turkey Point Nuclear Plant Units 6 & 7

Chap. 21 Design Changes Proposed In Accordance With ISG-11

Steve Franzone
Licensing Manager
New Nuclear Projects

Design Changes Proposed In Accordance With ISG-11

AP1000® Emergent Issues

- PXS Condensate Return
- Post Accident Main Control Room Operator Dose
- Hydrogen Venting Inside Containment
- Flux Doubling Compliance with IEEE 603
- Main Control Room Heat Up

Design Changes Proposed In Accordance With ISG-11

PXS Condensate Return

- **Problem Statement:**
  - The analysis performed during design certification assumed a constant condensate return rate of 90%
- **Issue Resolution:**
  - Plant changes have been incorporated to increase condensate return to the IRWST
    - -- Add downspouts to polar crane girder and internal stiffener to drain condensate directly to In-containment Refueling Water Storage Tank (IRWST)
      - – Minimizes losses associated with re-attaching flow to containment wall and with flow over support plates
    - -- Optimize IRWST gutter design and location
      - – Extended to collect above upper equipment hatch and personnel airlock
    - -- Changed routing of cables to hydrogen sensors
      - – Reduces quantity of support plates (obstacles) attached to the containment dome
  - Licensing Basis would not have been met without design changes

Design Changes Proposed In Accordance With ISG-11

PXS Condensate Return (cont.)

- **Conclusions:**
  - Design Basis Analysis demonstrates:
    - The PRHR closed loop cooling can maintain the plant in a safe, stable condition for 72 hours
  - Conservative, non-bounding analysis demonstrates:
    - PRHR closed loop cooling can cool the RCS to 420°F in less than 36 hours
    - PRHR closed loop cooling can maintain safe shutdown (< 420°F for at least 14 days)
    - Adiabatic analysis of the RCS is appropriate.

Design Changes Proposed In Accordance With ISG-11

Post-Accident Main Control Room Dose

- **Problem Statement:**
  - The certified design did not include direct dose contributions from the Main Control Room (MCR) Emergency Habitability System (VES) filter unit; direct filter dose increases the operator dose when considered
  - The Main Steam line break analysis did not model the most limiting release scenario: secondary side coolant release timing assumptions were non-bounding
  - Discrepancies were identified in the underlying shielding calculations for post-accident operator dose: AP1000 shielding design non-conservatively differed from the analysis model
- **Issue Resolution:**
  - A combination of design and analysis changes were needed to demonstrate operator doses satisfy General Design Criterion (GDC) 19
  - Reported doses decrease from DCD Revision 19

Design Changes Proposed In Accordance With ISG-11

Hydrogen Venting Inside Containment

- **Problem Statement:**
  - AP1000 design changes to containment layout were implemented without revision to supporting analyses for hydrogen diffusion flame
  - In one particular severe accident scenario (frequency = 6E-9/yr), a hydrogen diffusion flame may create a locally high temperature near containment pressure boundary, hatch, and penetrations
    - -- Analysis required to verify containment survivability
    - -- ITAAC revision is required to reflect containment layout design changes
- **Issue Resolution:**
  - Updated analysis confirms containment survivability during a hydrogen burn event

Design Changes Proposed In Accordance With ISG-11

Flux Doubling Compliance with IEEE-603

- **Problem Statement:**
  - The design did not comply with a portion of IEEE 603 Sub-clause 6.6 criteria:

    Whenever the applicable permissive conditions are not met, a safety system shall automatically prevent the activation of an operating bypass or initiate the appropriate safety function(s).
- **Issue Resolution:**
  - A new permissive, P-8, based on minimum required reactor coolant temperature for criticality (MTC), was added
  - Design now complies with IEEE-603

Design Changes Proposed In Accordance With ISG-11

Main Control Room Heat Up

- **Problem Statement:**
  - Throughout the design evolution of the MCR, the size and quantity of equipment have increased, raising the total MCR heat load. These increases result in a MCR temperature response exceeding the current licensing basis limit and equipment qualification conditions
  - A new more limiting transient where non-safety power is provided to non-safety equipment but the Nuclear Island Non-Radioactive Ventilation System (VBS) is NOT available was identified
- **Issue Resolution:**
  - Two stage automatic load shed
    - This automatic operation is proposed to maintain the required MCR environmental conditions
      - Only select non-safety loads are de-energized, with no impact to the minimum inventory of displays / controls provided by the primary dedicated safety panel
      - No impact to the plant controls & indication of plant parameters at operator workstations
      - Load shed circuitry is safety related

Design Changes Proposed In Accordance With ISG-11

Main Control Room Heat Up (cont.)

- **Issue Resolution (cont.):**
  - Additional Surveillance Requirements
    - -- Limit initial conditions for adjacent rooms in the updated MCR Heat Up analysis
    - -- Limit moisture content for air in the VES storage tanks
  - Human Factors Considerations
    - -- Analysis supports unlimited operator stay time at a wet bulb globe temperature (WBGT) Index of 90°F
      - – Acceptance criterion is from NUREG-0700
      - – Same limit is met for post-72 hour ancillary fan operation
  - Evaluation concludes that proposed changes confirm MCR temperature requirements are met and no limits are imposed on personnel stay time

QUESTIONS?

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

August 19, 2016

ACRS Presentation Outline
Day 2 (August 19, 2016)

ASE Section	Title
2.5	Geology, Seismology, and Geotechnical Engineering
3.5 3.7	Missile Protection Seismic Design
13.3	Emergency Planning
19	Probabilistic Risk Assessment

Project Management Team

- Manny Comar, Lead PM Turkey Point Units 6 and 7 COL
- Lisa Schleicher, Chapter 2 “Site Characteristics”
- Ruth Reyes, Chapter 3 “Design of Structures, Components, Equipment, and Systems”
- Jordan Hoellman, Chapter 21 “Design Changes Proposed in Accordance with ISG-11”

Technical Staff Review Team – Day 2

- **Section 2.5**
  - Alice Stieve
  - Meralis Plaza-Toledo
  - Dogan Seber
  - David Heeszel
  - Lisa Schleicher
  - Zuhan Xi
  - Luissette Candelario
- **Section 3.5**
  - Jerry Chuang
- **Section 3.7**
  - Alissa Neuhausen
  - Pravin Patel
- **Section 13.3**
  - Bruce Musico
- **Chapter 19**
  - Malcolm Patterson

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 2, Site Characteristics

Section 2.5 - Geology, Seismology, and Geotechnical Engineering

August 19, 2016

Review Team - ASE Chapter 2, Section 2.5
(Geology, Seismology, and Geotechnical Engineering)

- Technical Staff (Geoscience and Geotechnical Engineering Branches 1 & 2)
  - Alice Stieve, Ph.D., Geologist (Sections 2.5.1 & 2.5.3)
  - Meralis Plaza-Toledo, M.S., Geologist (Sections 2.5.1 & 2.5.3)
  - Dogan Seber, Ph.D., Sr. Geophysicist (Section 2.5.2)
  - David Heeszel, Ph.D., Geophysicist (Section 2.5.2)
  - Lisa Schleicher, Ph.D., Geophysicist (Section 2.5.2)
  - Zuhan Xi, M.S., Geotechnical Engineer (Sections 2.5.4 & 2.5.5)
  - Luissette Candelario, M.E., Geotechnical Engineer (Sections 2.5.4 & 2.5.5)

Section 2.5.1 – Geologic Characterization Information

Section 2.5.3 – Surface Deformation

Sections 2.5.1 & 2.5.3

For Section 2.5.1 staff finds that

- The geologic characteristics of the site region will not affect the design and safe operation of the proposed units
- The geologic characteristics of the site region are in support of the seismic hazard evaluations in Section 2.5.2 and the surface deformation evaluation in Section 2.5.3

For Section 2.5.3, staff finds that

- Per 10 CFR 100.23(d)(2), the potential for surface tectonic and nontectonic deformation is negligible within the site vicinity
- Because of possible limestone voids in the sub-foundation, this section is integrated with safety findings for Section 2.5.4

Primary Topics for Staff's Review

- Tectonic setting and age of tectonic structures in the site region including offshore marine environments

- Extent of limestone dissolution in the subsurface at the site based on characterization of karst features in the site vicinity and region

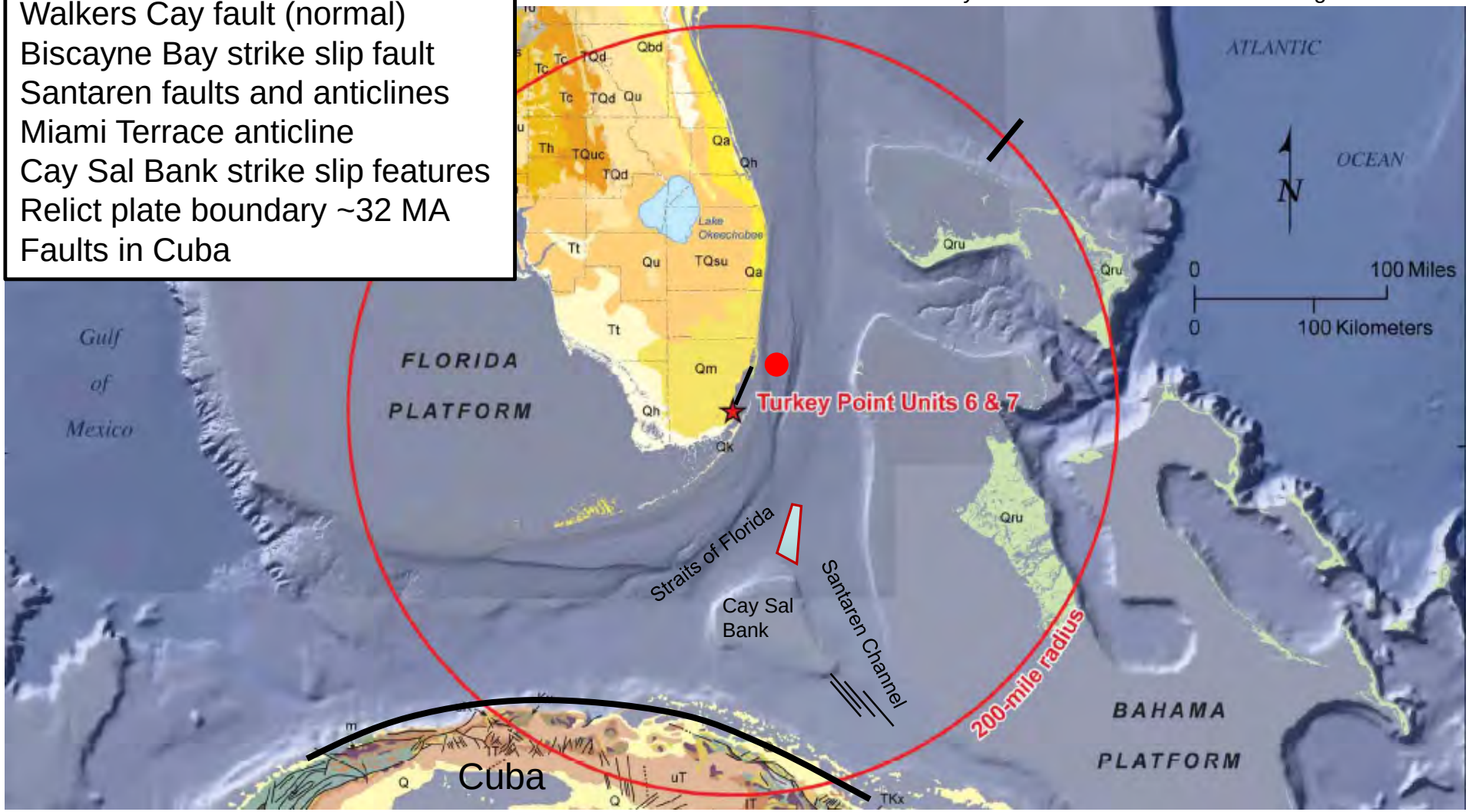
Staff Actions for This Review

- Reviewed COL FSAR Section 2.5.1 and 2.5.3 and developed 43 RAIs
- Independently reviewed publications provided in the COL FSAR as well as pertinent publications identified by staff
- Met with COL applicant in public meetings to discuss various technical issues that were closely interrelated in this COL review
- Conducted two site audits during the safety review
- Reviewed and evaluated the SSHAC level 2 study for tectonic features found in offshore marine environment in the Straits of Florida and the Santaren Channel
- Reviewed and evaluated a SSHAC study regarding the implementation of the Cuba seismic source

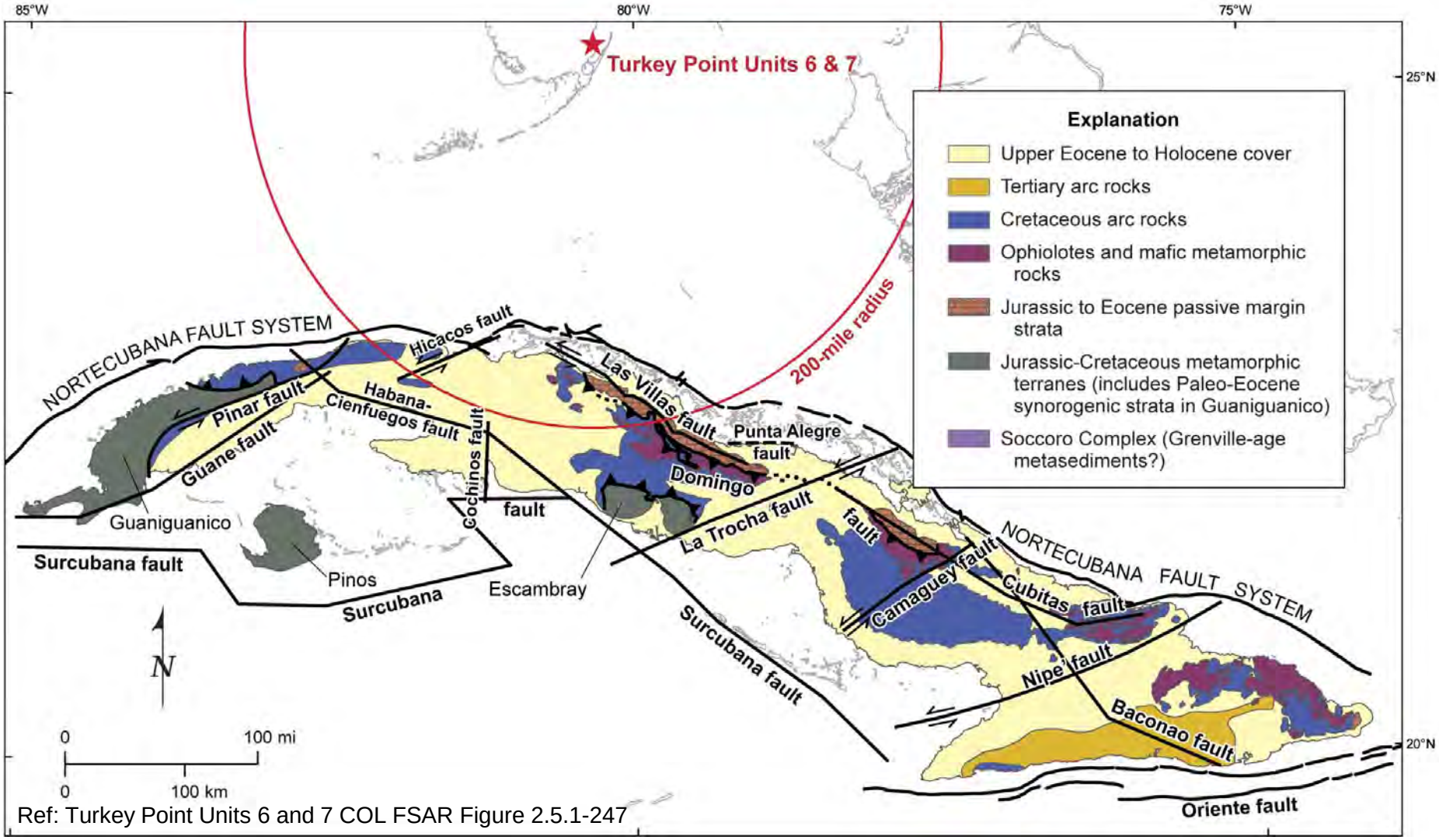
Tectonic Features within 200 Miles of Site

Faults and folds:
Walkers Cay fault (normal)
Biscayne Bay strike slip fault
Santaren faults and anticlines
Miami Terrace anticline
Cay Sal Bank strike slip features
Relict plate boundary ~32 MA
Faults in Cuba

Ref: Modified Turkey Point Units 6 and 7 COL FSAR Figure 2.5.1-201



Cuba Faults and Potential Impacts on Seismic Hazard



Ref: Turkey Point Units 6 and 7 COL FSAR Figure 2.5.1-247

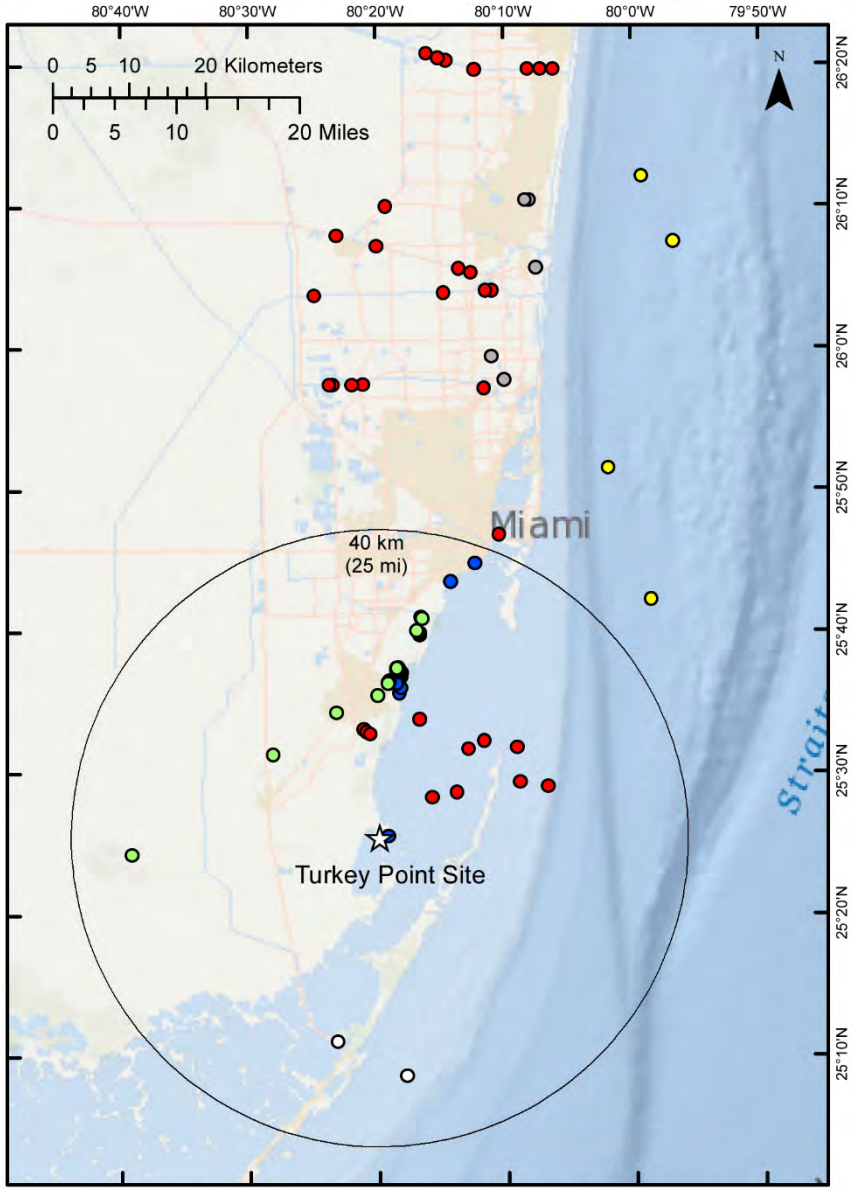
PSHA Sensitivity Studies for Tectonic Features

Fault	Age	Sensitivity analysis
Biscayne Bay	middle Miocene to early Pliocene	none
Miami Terrace anticline	Miocene to Plio-Pleistocene	NRC Sensitivity
Cay Sal Bank features	Quaternary	NRC Sensitivity
Santaren Anticline	Quaternary	Applicant Sensitivity
Walkers Cay	Quaternary	Applicant Sensitivity
Faults in Cuba	Various/ many undetermined	NRC/Applicant: Areal + fault source sensitivity test

Potential for Surface Deformation

- Florida Peninsula and platform are part of a large, long-standing carbonate bank system (from 200 Ma until today)
- Various limestone/dolostone/anhydrite/minor clastic formations underlie the Turkey Point Units 6 and 7 site
- Review focused on potential for undetected subsurface voids from limestone dissolution
- Geology review closely interfaced with Geotechnical Engineering review

Distribution map of Features Associated with Limestone Dissolution Site Vicinity



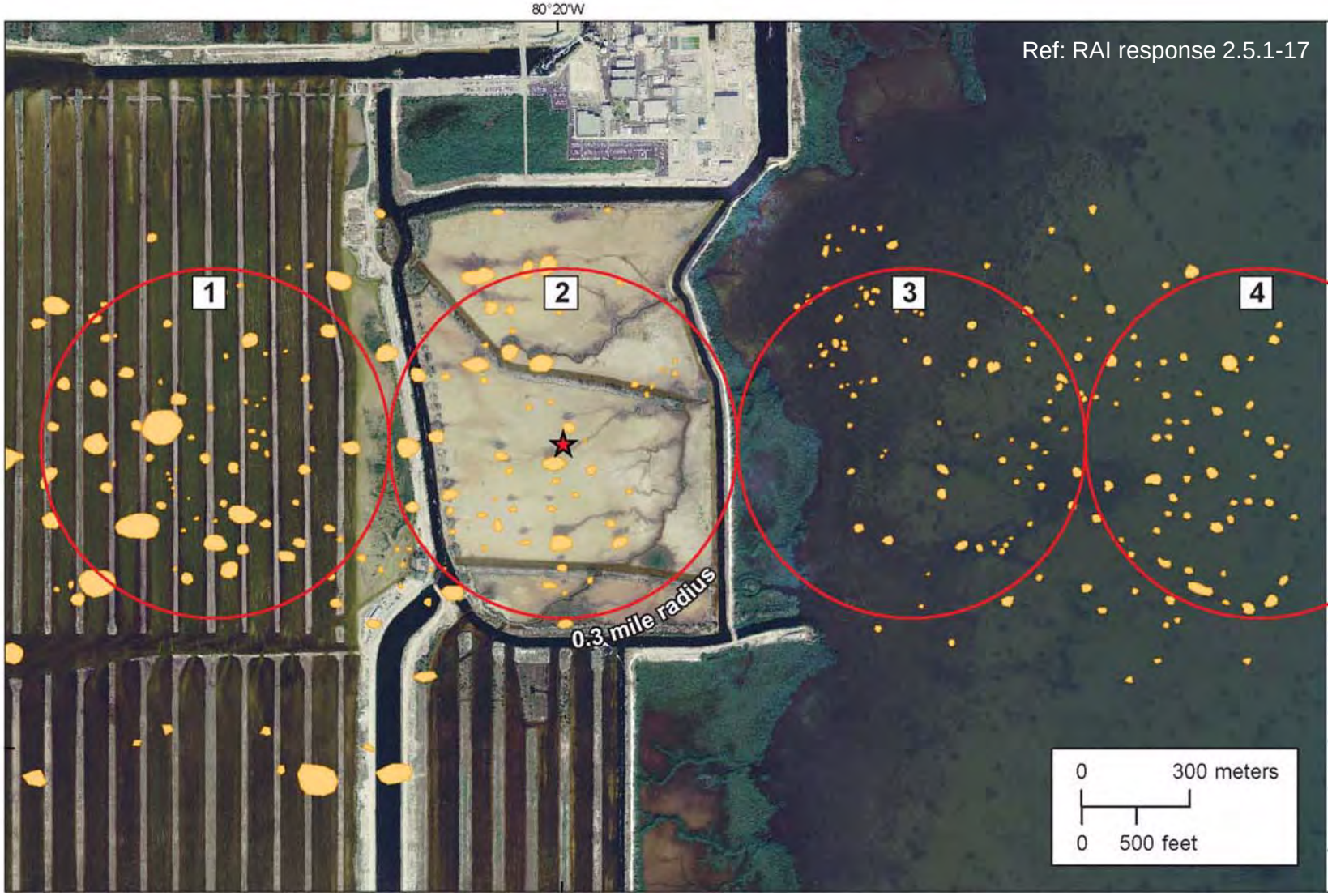
Coordinate System: NAD_1983_2011_StatePlane_Florida_East_FIPS_0901_Ft_US
Projection: Transverse_Mercator

Legend

- Cave
- Paleo-Sinkhole
- Seismic Sag or Collapse Feature
- Spring
- Submarine Sinkhole
- Surface Sinkhole/Subsidence Feature

Based on Table 1
in Response to RAI 2.5.1-39

Surface Dissolution Features at the Site



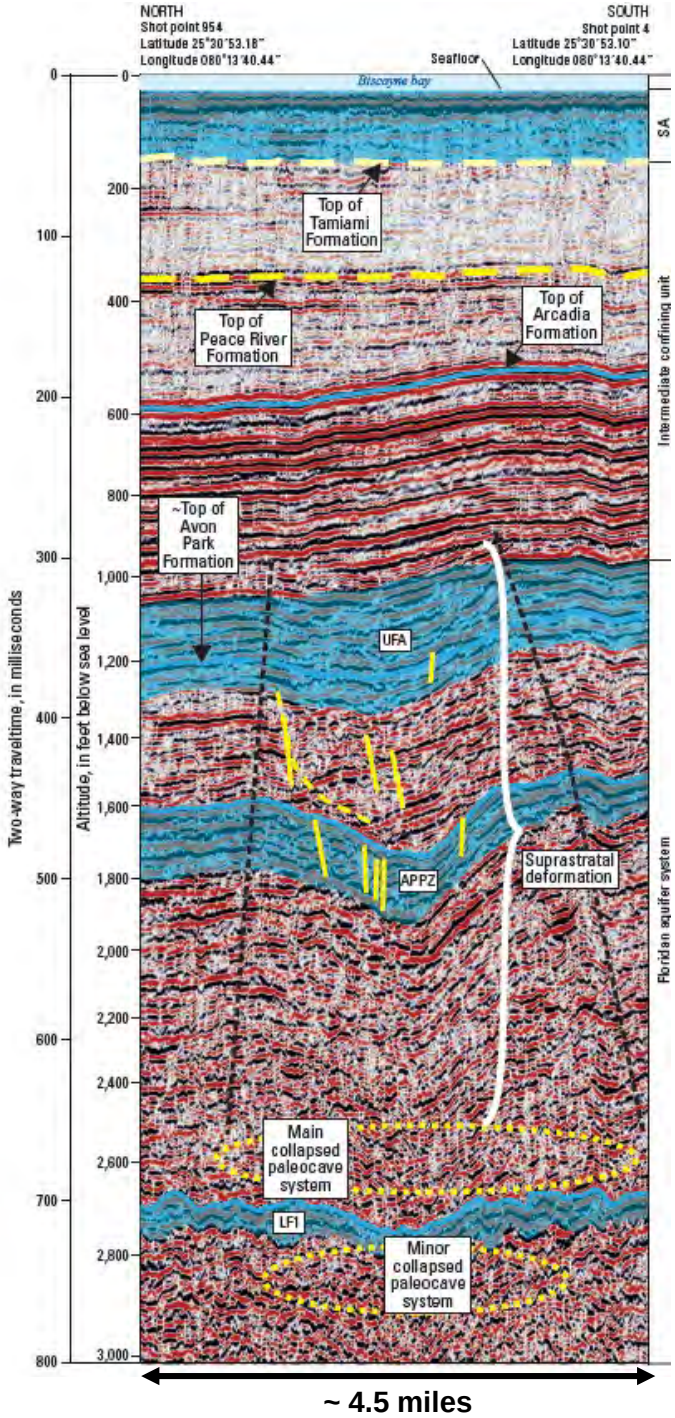
Core Samples: Calcium carbonate crystals coating touching-vug porosity zone

Zones of secondary porosity in the Key Largo and Fort Thompson Formations

Voids formed during mixing of fresh and salt waters

$CaCO_3$ now precipitating rather than dissolving

Structural Sags Identified in Seismic Reflection Data



Top of Arcadia Formation

~400 ft below grade at the Turkey Point Units 6 and 7 site

Ref: Cunningham, 2015

Stratigraphic Position of Karst features Near the Site

ERATHEM	SYSTEM	SERIES	HYDRO-GEOLOGIC UNIT		STRATIGRAPHIC UNIT		LITHOLOGY	APPROXIMATE TOP ELEVATION (ft NAVD 88)	APPROXIMATE THICKNESS (ft)
CENOZOIC	QUATERNARY	HOLOCENE			organic muck		organic soil and silt	0	3
		PLEISTOCENE	Surficial aquifer system	Biscayne aquifer	Miami Limestone		sandy, oolitic limestone	-3	25
					Key Largo Limestone		well indurated, vuggy, coralline limestone	-28	22
					Fort Thompson Formation		poor/well indurated fossiliferous limestone	-50	65
	TERTIARY	PLIOCENE		Semi-confining unit	Tamiami Formation		sand and silt with calcarenitic limestone	-115	105
		MIOCENE	Intermediate confining unit		Hawthorn Group	Peace River Formation	silty calcareous sand and silt	-220	235
						Arcadia Formation	calcareous wackestone with indurated limestones, sandstone, and sand	-455	>160

formation contact based on natural gamma signature

drilling ended at -516.5 ft

Dry caves

Regional unconformity

Subsurface 2 Zones of secondary porosity

Vegetative depressions In Biscayne Bay

Seismic Sags ( )
Hypogenic dissolution
Collapsed paleocave system

Ref: Modified Turkey Point Units 6 and 7 COL FSAR Figure 2.5.1-332

Resolution of Limestone Dissolution Issues

- Applicant developed a grouting plan for the subsurface beneath the nuclear island for dewatering and constraining open voids in the Key Largo and Fort Thompson Formations (RAI 82, Question 2.5.4-26)

- Staff's evaluation of the plan and associated ITAAC will be discussed by geotechnical staff later in this presentation

Surface Deformation Finding

Staff conclude that surface deformation at the site is negligible based on:

- data that indicate the subsurface seismic sags in Biscayne Bay are characteristically at or below the Arcadia unconformity
- the deeper boreholes at the Turkey Point Units 6 and 7 site reveal no large voids
- the grouting plan for the power block sub-foundation and associated ITAAC

License Conditions and ITAAC

- ASE Section 2.5.3.5 identifies a geologic mapping License Condition for Turkey Point Units 6 and 7 and defines it as the responsibility of the applicant (License Condition 2.5.3-1)

Section 2.5.2 - Vibratory Ground Motion

Section 2.5.2 - Vibratory Ground Motion

COL application review for Section 2.5.2 focused on determining whether the FSAR provided sufficient information and adequately evaluated the seismic hazard at the site and established an adequate ground motion response spectra (GMRS)

Staff Actions for This Review

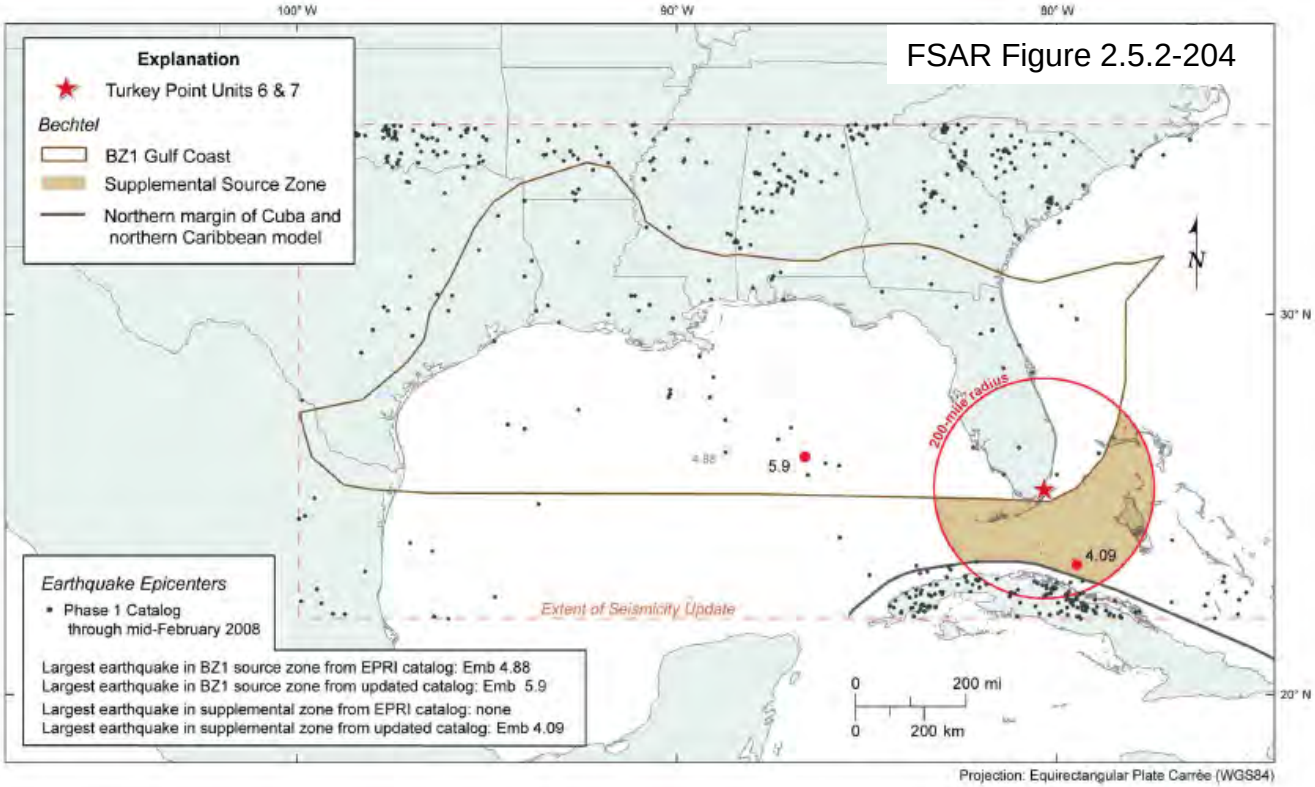
- Reviewed COL FSAR and developed 13 RAIs for section 2.5.2
- Staff reviewed external publications relevant to understanding vibratory ground motion issues at the site
- Conducted two site audits during the review
- Participated in a 3rd audit (locally) for the evaluation of the SSHAC level 2 study for tectonic features found in offshore marine environment (Section 2.5.1)
- Conducted sensitivity studies and confirmatory analyses as appropriate to test applicants inputs and assumptions

Primary Topics for Staff Review

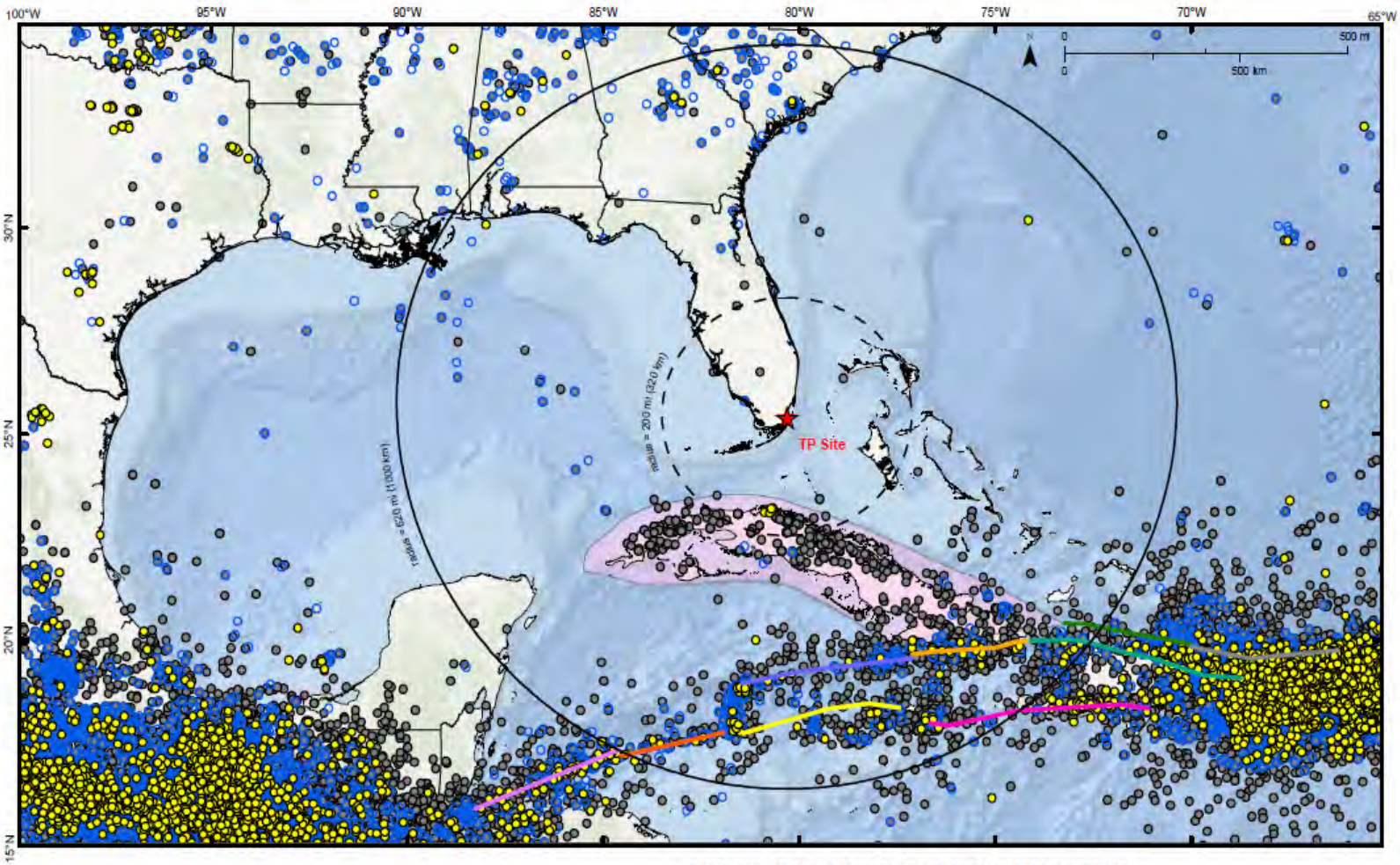
1. Applicant's hazard characterization using updated older models (EPRI-SOG) compared to the most recent NRC endorsed CEUS-SSC model
2. Potential hazard from sources outside of EPRI – SOG
   - Cuba and greater Caribbean Region
   - Local sources (< 200 mi (320 km) from the site)
     - Miami Terrace Anticline
     - Cay Sal Bank features
3. New Caribbean ground motion model (GMM)
4. Site response and confirmatory calculations

EPRI – SOG and Supplemental Source Zones

- Applicant updated seismicity to account for time since publication of EPRI – SOG (1980s)
- Applicant updated or added/extended source zones as appropriate to account for limited extent of EPRI – SOG model
- Used Charleston seismic source from Vogtle FSAR



Staff's Seismicity Confirmatory and Applicant's Cuba and Caribbean Sources



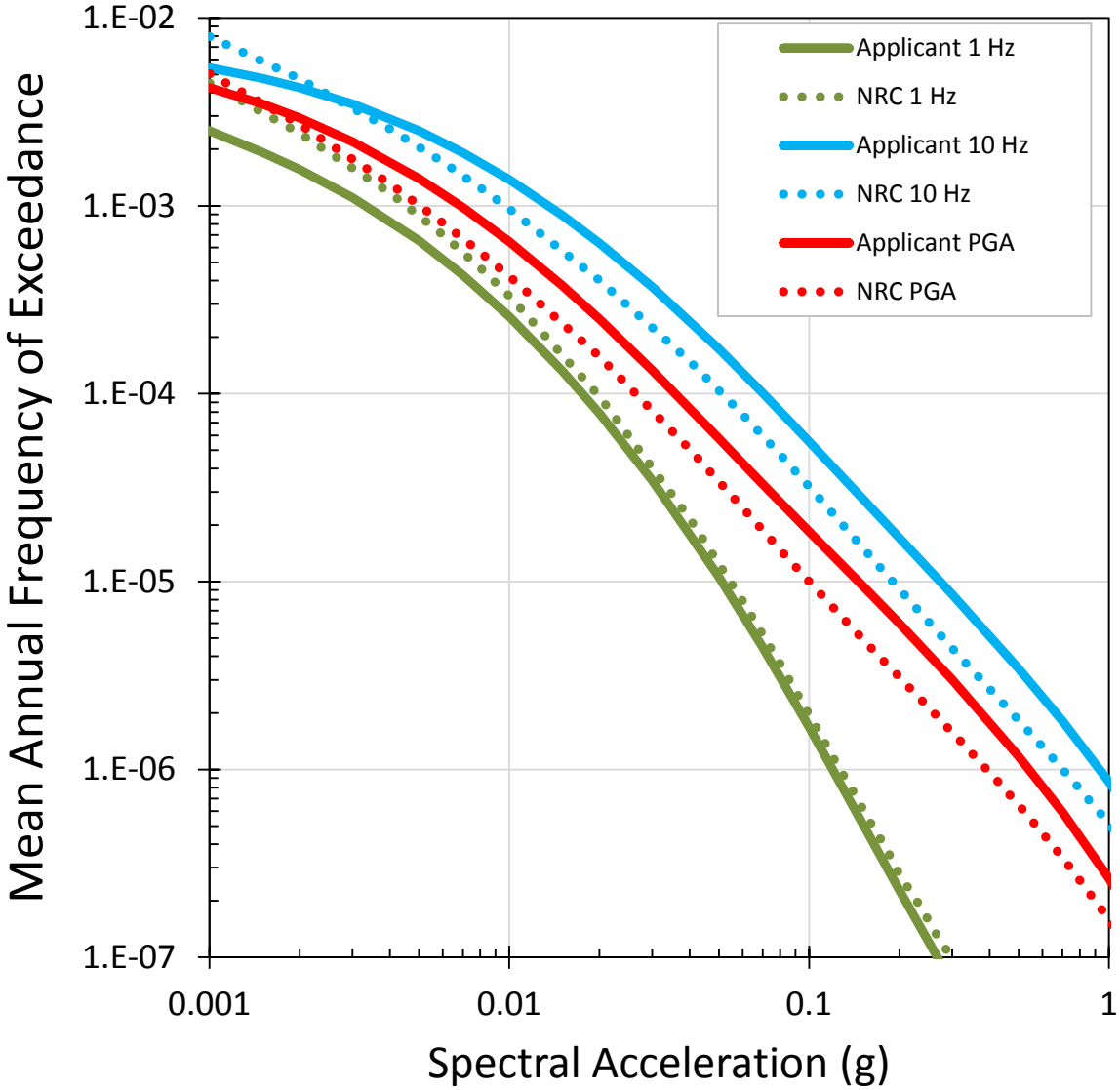
Earthquakes ≥ Magnitude 3.0

- Applicant Catalog
- NRC Confirmatory Catalog
- Post-catalog events through January 7, 2015

Applicant's Seismic Sources from Cuba and the Caribbean

- Cuba (Source 1)
- Oriente fault - western (Source 2)
- Oriente fault - eastern (Source 3)
- Septentrional fault (Source 4)
- Northern Hispaniola fault - western (Source 5)
- Northern Hispaniola fault - eastern (Source 6)
- Swan Isalnds fault - western (Source 7)
- Swan Islands Fault - eastern (Source 8)
- Walton-Duanvale fault (Source 9)
- Plantain Garden - Enriquillo fault (Source 10)

Staff's PSHA Confirmatory Calculations for CEUS



Applicant's model: Updated EPRI-SOG

Staff's model: NUREG-2115

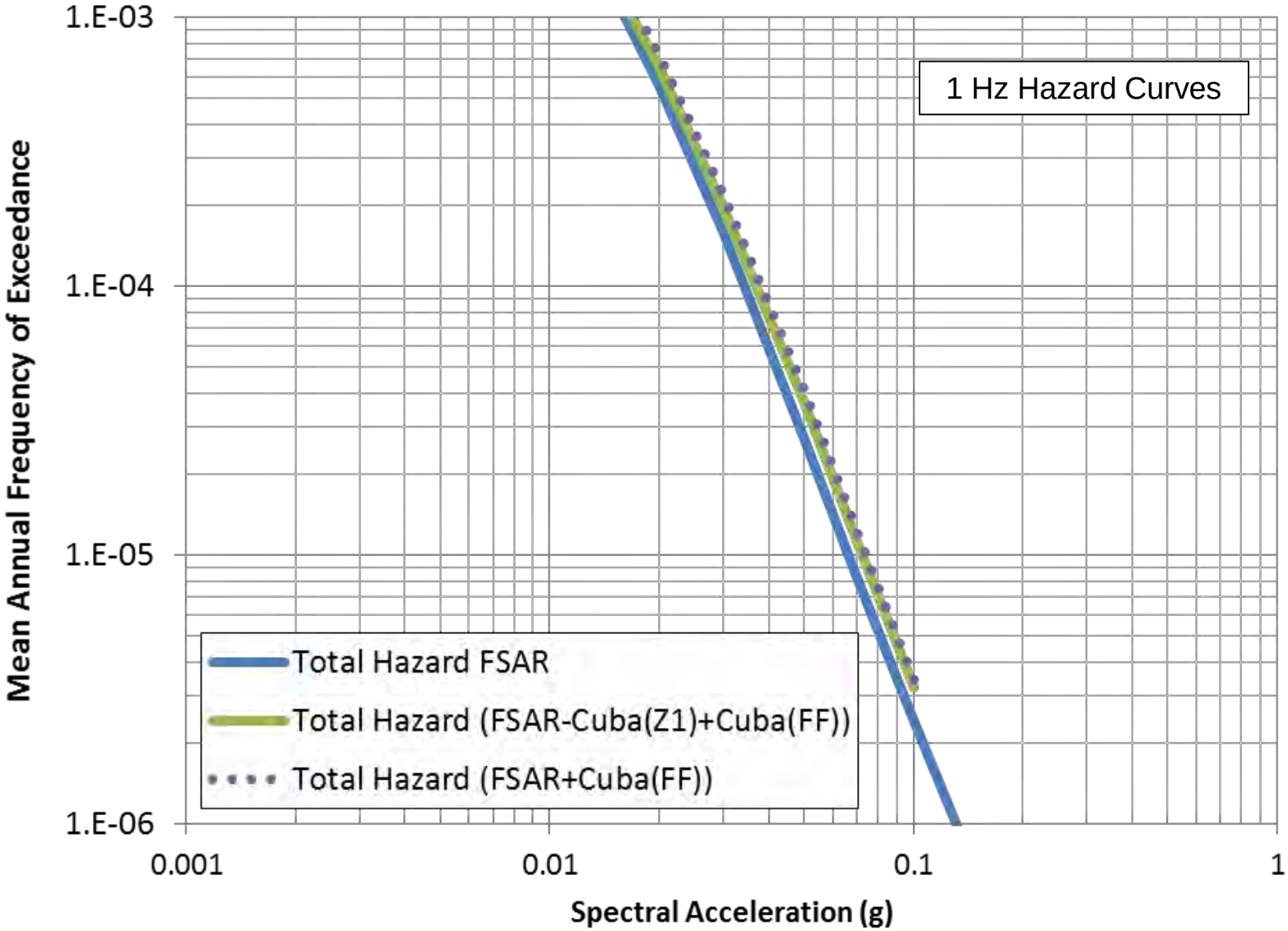
Characterization of Cuba Sources

Applicant evaluated Cuba as a single areal source zone

- In response to staff review, applicant considered different source configurations as part of a sensitivity study
  - Single areal source
  - Single areal source with increase in seismicity
  - Individual fault sources

- Did not consider single source zone with explicit faults

Staff's Sensitivity Analysis for Cuba Source



Caribbean Ground Motion Models

- Applicant developed new GMM for the Cuba and Caribbean seismic sources
- Staff requested additional information on the applicability of the new GMM for the region between Cuba and Florida
- Applicant provided new empirical data and analyses
- Staff conducted sensitivity calculations and determined new Caribbean GMM was adequate for calculating seismic hazards at Turkey Point site

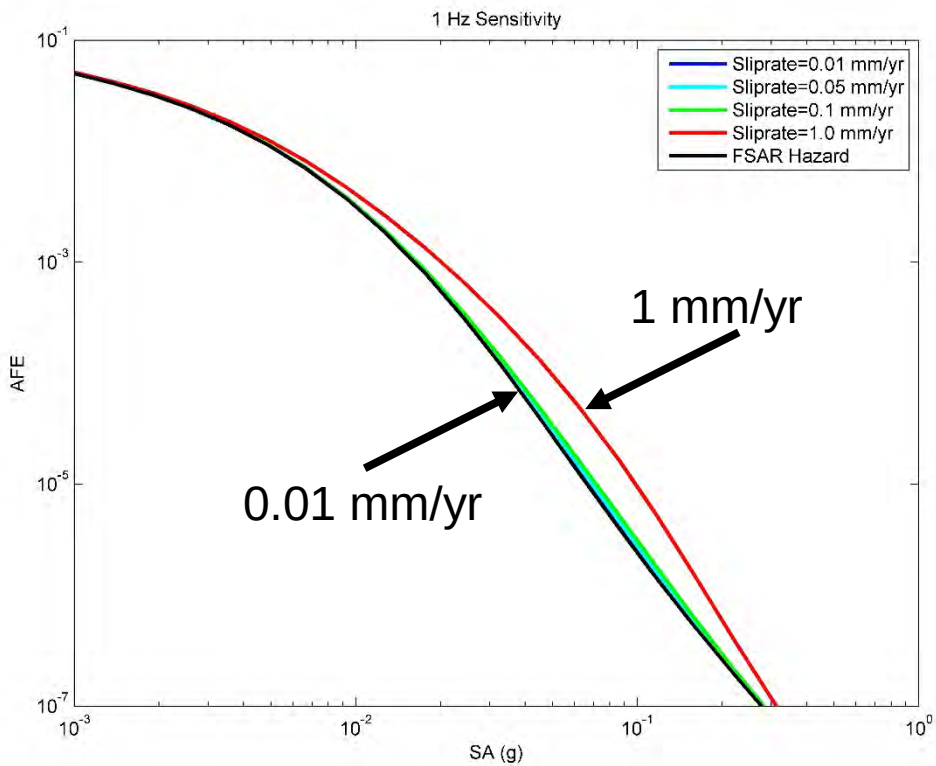
Local Seismic Sources

Staff performed PSHA sensitivity studies to assess hazard impacts of potential local tectonic sources not explicitly included in EPRI-SOG

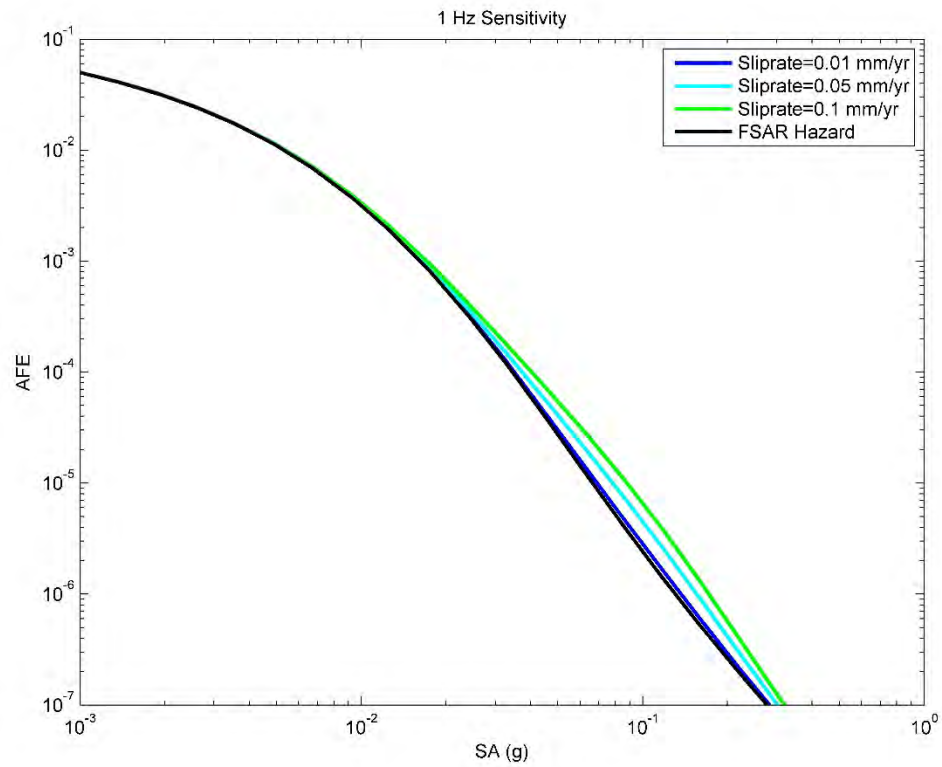
- Staff Used
  - Most recent NRC-endorsed GMM (EPRI, 2013)
  - Source geometries obtained from geologic information
  - Varying rates of fault slip estimates
- Staff concluded that these local sources produce negligible input to the total seismic hazard

PSHA Results of Two Local Tectonic Features

Cay Sal Bank Features



Miami Terrace Anticline

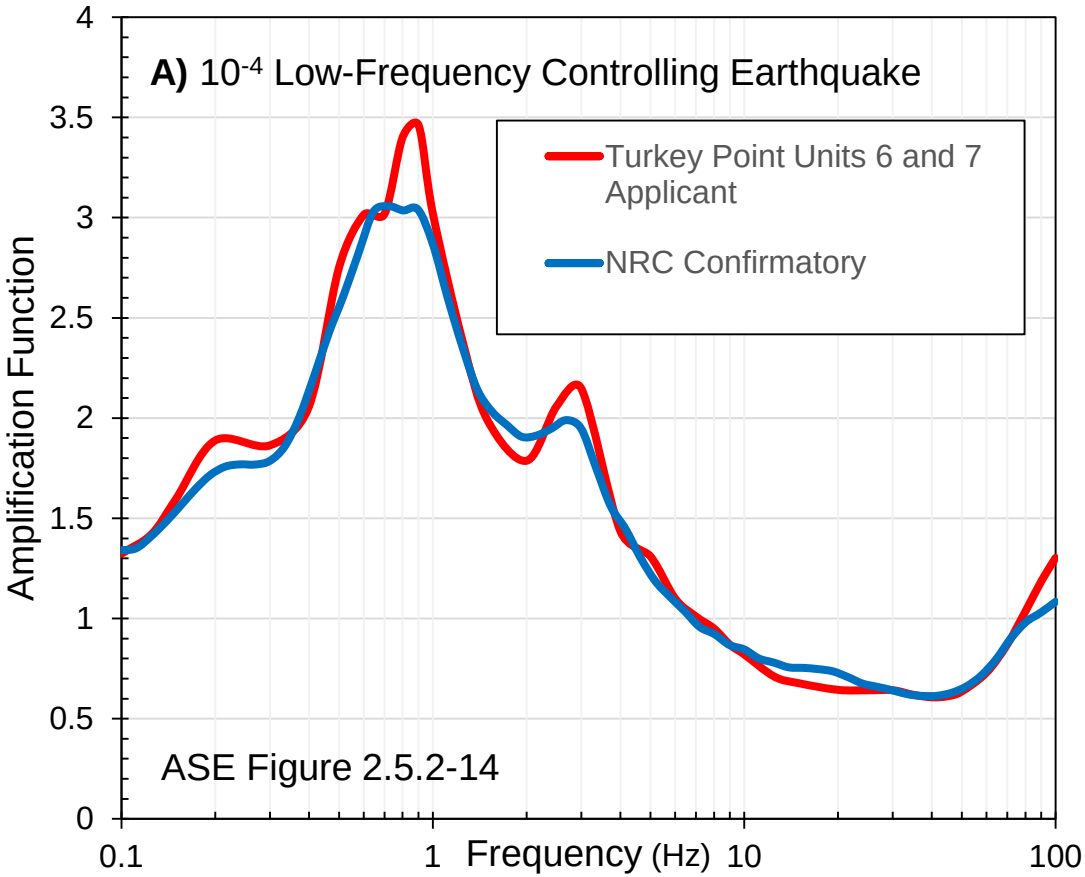


Staff Site Response Confirmatory

Staff used:

- Hazard results
- Site soil and rock properties as described in FSAR Section 2.5.4
- Alternative software

Results indicate that amplification functions are similar across all frequencies.



Section 2.5.4 - Stability of Subsurface Materials and Foundations

Section 2.5.5 - Stability of Slopes

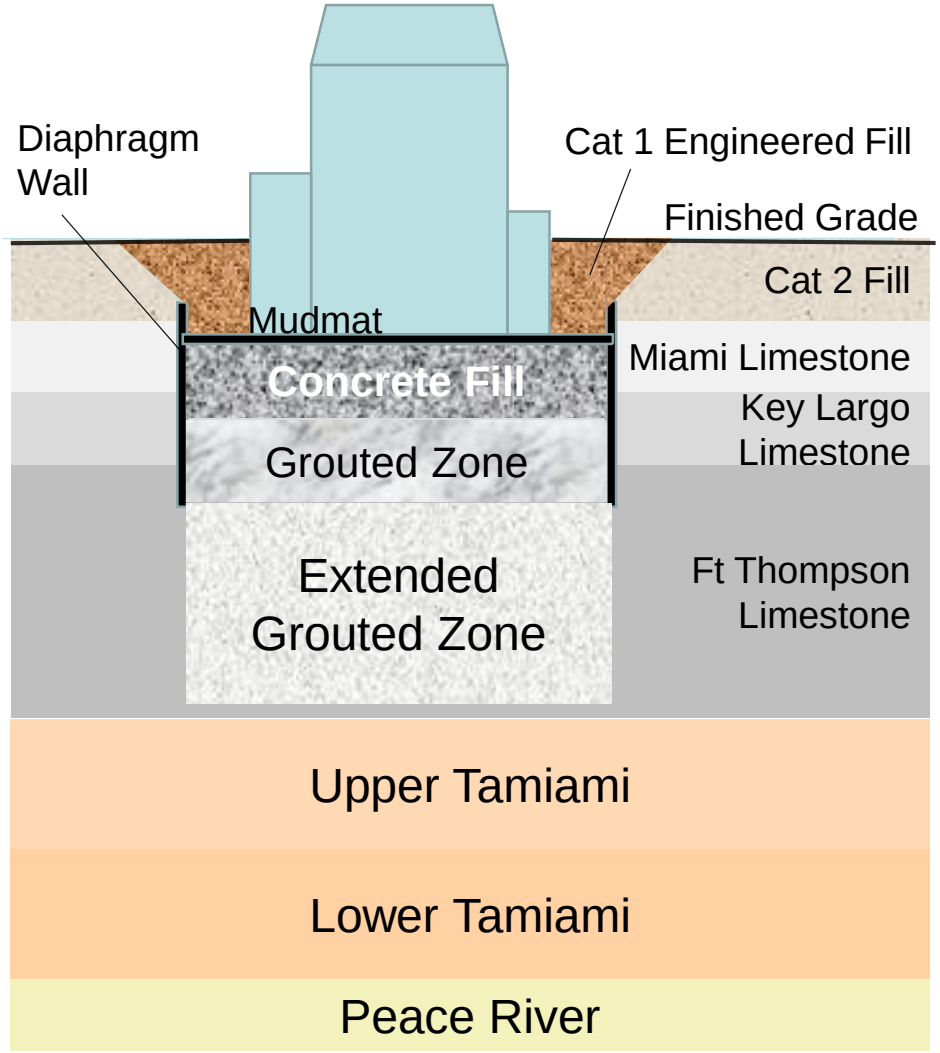
Review of FSAR Section 2.5.4

- **Staff's review included evaluation of:**
  - Engineering properties of subsurface materials
  - Foundation interfaces
  - Geophysical surveys
  - Excavation and backfill
  - Groundwater conditions
  - Response of soil and rock dynamic loading
  - Liquefaction potential
  - Static and/or dynamic stability (bearing capacity, settlement, and lateral earth pressure)

- **Status of the staff's Safety Evaluation:**
  - No open items
  - Two site specific ITAACs
  - One confirmatory item (RAI 2.5.4-26)

Excavation, Grouting, and Backfill

- Surficial muck/peat will be removed from the plant area and replaced with compacted limerock
- Under the power block area (within the diaphragm walls)
  - Miami Limestone and upper portions of Key Largo Limestone will be replaced with 19’ thick concrete fill
  - 25’ thick zone will be grouted fully
  - Additional 50’ thick zone will be subjected to further grouting (to constrain potential void size ≤ 20’)



Site Specific ITAACs

- **ITAAC for concrete fill under seismic Category I structures**
  - First lift of concrete fill placed under the nuclear island basemat, containment building, shield building, and auxiliary building meets durability requirements of ACI 201.2R-08, Table 6.3 for Class 2 sulfate exposure
  - Concrete fill placed under the nuclear island basemat, containment building, shield building, and auxiliary building is designed, constructed, and tested as specified in ACI 207.1R-05

- **ITAAC for seismic Category I structure foundation grouting**

  confirmatory item: Updates to the FSAR in a future revision to include the information and ITAAC for seismic Category I structure foundation grouting in FSAR 2.5.4 are tracked as a confirmatory item with RAI 2.5.4-26

Potential Subsurface Voids Created by Limestone Dissolution

- Applicant identified dissolution features
  - Vegetative depressions within the Miami Limestone
  - Secondary porosity in limestones
- Site geotechnical subsurface investigations
  - Outside vegetated depressions and drainages
    - 20.1’ total of tool drops (0.3%) are observed, in 7918.4’ cored length
    - Individual drops in the vertical borings range from 0.4’ - 4’ (1.5’ max within building footprints)
  - Inside vegetated depressions and drainages
    - 15.2’ total of tool drops (4.3%) are observed in 356.4’ cored length
    - Individual drops in the inclined borings range from 0.3’ - 2.5’

Staff Examination of Limestone Core Samples

Dissolution voids in the Key Largo Formation

Dissolution voids in the Fort Thompson Formation

Summary of Site Investigations and Results

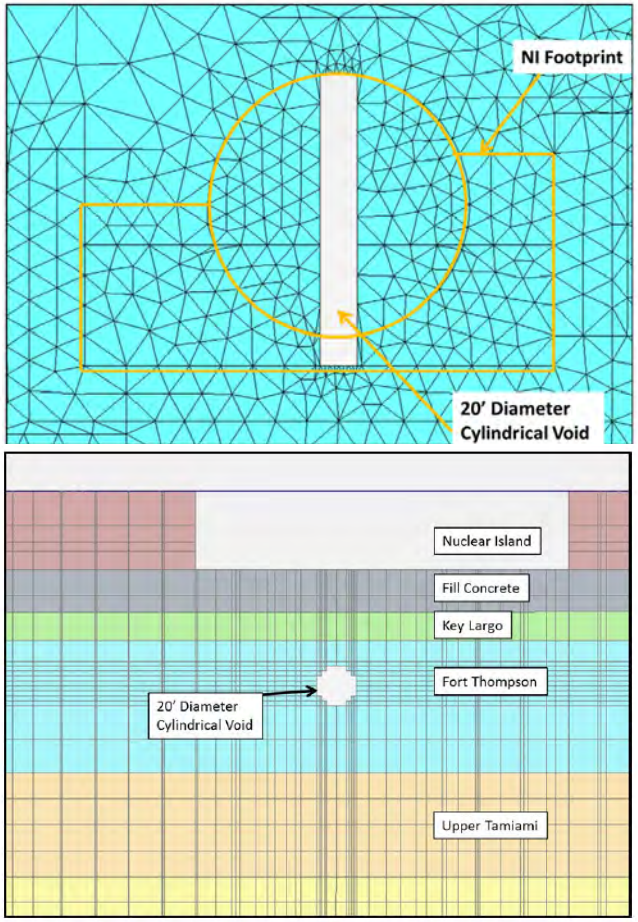
- Geotechnical investigations followed RG 1.132 to characterize the site
- Initial and supplemental site investigations established foundation design parameters
- Frequency of encountering an interpreted tool drop is less than 0.5% site-wide based on performed site investigations
- Maximum length of interpreted tool drops in the borings is limited to 4’ site-wide and 1.5’ within the building footprints
- Available data from site investigations suggest no significant large voids beneath the site
- However, grouting program is warranted for minimizing the impacts of potentially undetected voids

Grouting Program Constrains Potential Subsurface Voids

- The subsurface grouting program is planned for dewatering purposes and in the determination of constrained void sizes
  - Grouting ITAAC will ensure that
    - Remaining voids in the Grouted Zone (between El. -35’ to -60’) are structurally insignificant.
    - Remaining voids in the Extended Grouted Zone (between El. -60’ to -110’) have a maximum equivalent spherical diameter of equal to or less than 20’
  - Grout stage closure criteria will be developed based on results of the grout test program
  - Grout mixes will be tested to assess mobility, stability, and durability
  - Mix design, material control, laboratory testing, grout placement, and field testing will be performed under a quality program

Review of Applicant's Sensitivity Analysis: Effect of 20' Diameter Void on Subsurface Stability

- Postulated 20' diameter cylindrical void beneath nuclear island just below Grouted Zone
- Evaluated effects of void on settlement, bearing capacity, and potential tension in concrete fill
- Analysis shows void does not present stability concerns to subsurface material at site



Copy from Applicant's Response to RAI 2.5.4-26, Figures 5 and 6

Staff Assessment of Potential Subsurface Dissolution Voids

- Staff confirmed results of applicant's site characterization by examination of borehole lithologic and geophysical logs, and rock core samples during site visits, audits, and FSAR review
- Staff concluded applicant's postulated 20' void in Extended Grouted Zone is conservative based on data from geotechnical investigation and configuration of primary grouting holes
- Staff determined applicant's sensitivity analysis for a cylindrical void with a 20' diameter circular cross-section across nuclear island is conservative based on AP1000 DCD requirements
- Staff concluded that with implementation of ITAAC the limestone under concrete fill will be grouted to constrain voids so that stability of subsurface materials will not be a concern

Section 2.5.4 Stability of Subsurface Materials and Foundations

Staff Concluded that the applicant:

- complied with the applicable regulations
- conducted its investigations at an appropriate level of detail
- included adequate margins of safety in the design analyses for the construction and operation of the nuclear power plant

Updates of the FSAR in a future revision to include information related to RAI 2.5.4-26 (grouting program to constrain potential voids)

Section 2.5.5 Stability of Slopes

FSAR Section 2.5.5 addresses the stability of all earth and rock slopes, both natural and manmade (cuts, fill, embankments, dams, etc.) whose failure, under any of the conditions to which they could be exposed during the life of the plant, could adversely affect the safety of the plant

Staff Evaluated:

- Slope characteristics
- Evaluation of design criteria and design analyses

Section 2.5.5 Stability of Slopes

Staff Concluded: No potential slope failure at site would adversely affect safety of nuclear power plant structures:

- design does not use safety-related dams or embankments and there are no existing upstream or downstream dams that could affect safety-related facilities
- Permanent slopes are directed away from the power block and have a maximum grade of 0.5%
- Mechanically stabilized earth (MSE) retaining walls sit no closer than 500’ away from the seismic Category I structures, and, therefore, potential failure of the MSE walls would not affect safety-related structures
- Temporary slopes that will be excavated for plant construction do not adversely affect the safety of the nuclear power plant facilities
- Applicant complied with the applicable regulations

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Protecting People and the Environment

Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 3, Design of Structures, Components, Equipment, and Systems

August 19, 2016

ASE Chapter 3, Design of Structures, Components, Equipment, and Systems

- **Section 3.1** – Conformance with Nuclear Regulatory Commission General Design Criteria
- **Section 3.2** – Classification of Structures, Components, and Systems
- **Section 3.3** – Wind and Tornado Loadings
- **Section 3.4** – Water Level (Flood) Design
- **Section 3.5** – Missile Protection
- **Section 3.6** – Protection against the Dynamic Effects Associated with the Postulated Rupture of Piping
- **Section 3.7** – Seismic Design
- **Section 3.8** – Design of Category I Structures
- **Section 3.9** – Mechanical Systems and Components
- **Section 3.10** – Seismic and Dynamic Qualification of Seismic Category I Mechanical and Electrical Equipment
- **Section 3.11** – Environmental Qualification of Mechanical and Electrical Equipment

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Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 3, Design of Structures, Components, Equipment, and Systems
Section 3.5 – Missile Protection

Jerry Chuang
Senior Structural Engineer, NRO/DEIA/SEB

August 19, 2016

NRC Review Team – ASE Chapter 3 Section 3.5 – Missile Protection

- Technical Staff
  - Jerry Chuang, Structural Engineering Branch

- Project Managers
  - Ruth Reyes, AP1000 COL
  - Manny Comar, AP1000 COL

Introduction

- **Turkey Point FSAR Section 3.5 is incorporated by reference (IBR) with PTN COL 3.5-1**

- **Turkey Point Hurricane Auto Missile Speed Exceedance**
  - Horizontal velocity exceeds AP1000 DCD design basis by 87%
    - Turkey Point 180 mph vs. AP1000 DCD 105 mph

- **Safety Analysis for Missile Impacts**
  - Most energetic missile (automobile) selected from RG 1.221 specified hurricane missile spectrum
    - Auto vs. ball and pipe
  - Most vulnerable building selected (Auxiliary Building)
    - Auxiliary Building wall thickness (20-23 inches) vs. Shield Building Wall (36 inches)

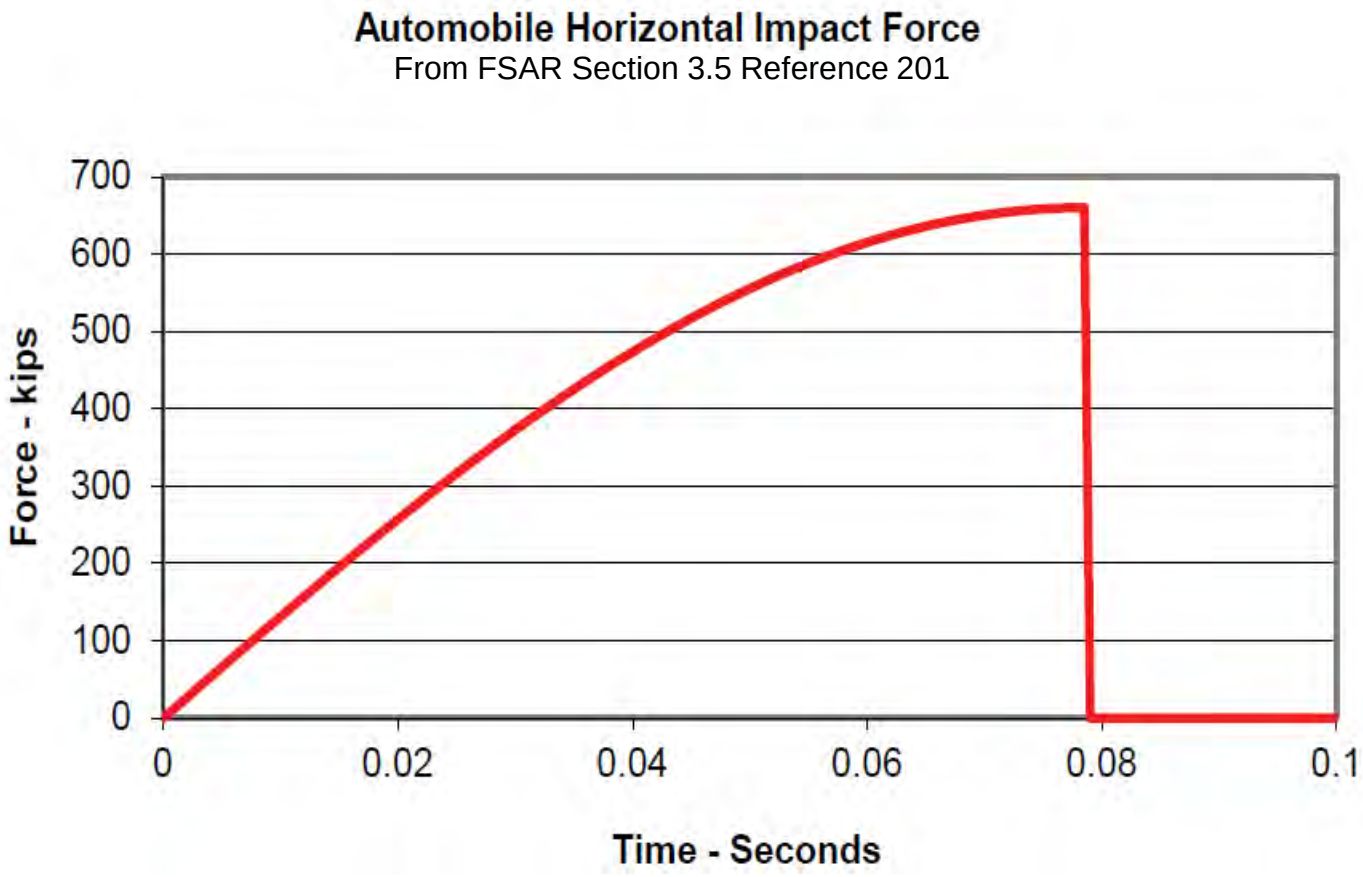
Analysis Methodology

- AP1000 DCD used equivalent static method:
  - Only simple hand calculations needed
  - High degree of conservatism built-in
    - Rigid support assumed
    - Increased demand by dynamic load factor of 2
- Additionally, Turkey Point used dynamic finite element model (FEM) time-history analysis method as well as single degree of freedom analyses:
  - More precise

Finite Element Analysis of Auxiliary Building

- 3D FEM
- 4,000 lbs automobile (6.6 ft by 4.3 ft) surface loading
- Time-dependent load following the AP1000 DCD loading function
- 7 most vulnerable walls selected for time-history evaluations at 3 locations:
  - Center
  - Corner
  - Mid-edge

Finite Element Analysis of Auxiliary Building



ACI 349 Code Specifications

- Reinforced concrete shear capacities (ACI 349 Section 11.12.2)
  - One-way Beam Reaction: 112 psi
  - Two-way Beam Reaction: 224 psi

- Shear demands for mid-edge impacts at the wall panel
  - Peak Stress exceeds allowable 112 psi
  - However, averaged shear stress 88 psi over effective width is less than the allowable 112 psi
  - Meet ACI 349 Section 11.12.12 provisions

Conclusions

- FEM dynamic time history analysis showed
  - One-way shear stress demand at the critical section is less than the shear capacity permitted by code
  - One-way beam response shear capacity of concrete wall used in the standard design is 112 psi based on ACI Code allowables
- Based on ACI Code, the staff concluded that the Turkey Point wall panels are adequate against hurricane-induced missile impacts

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Turkey Point
Units 6 and 7 COL Application

ASE Chapter 3, Design of Structures, Components, Equipment, and Systems
Section 3.7 – Seismic Design

Pravin Patel
Structural Engineer, NRO/DEIA/SEB

August 19, 2016

NRC Review Team – ASE Chapter 3 Section 3.7 – Seismic Design

- Technical Staff
  - Pravin Patel, Structural Engineering Branch
  - Alissa Neuhausen, Structural Engineering Branch

- Project Managers
  - Ruth Reyes, AP1000 COL
  - Manny Comar, AP1000 COL

Chapter 3.7 Supplemental Information Items

PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions

PTN SUP 3.7-2/SUP 3KK-1

Seismic Category II/I Interaction

PTN SUP 3.7-2/SUP 3KK-1

Maximum Relative Displacement between Nuclear Island (NI) and Adjacent Building Foundation

PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions

Issue

The applicant developed both the GMRS and the performance based surface response spectra (PBSRS) following the guidance in DC/COL-ISG-017.

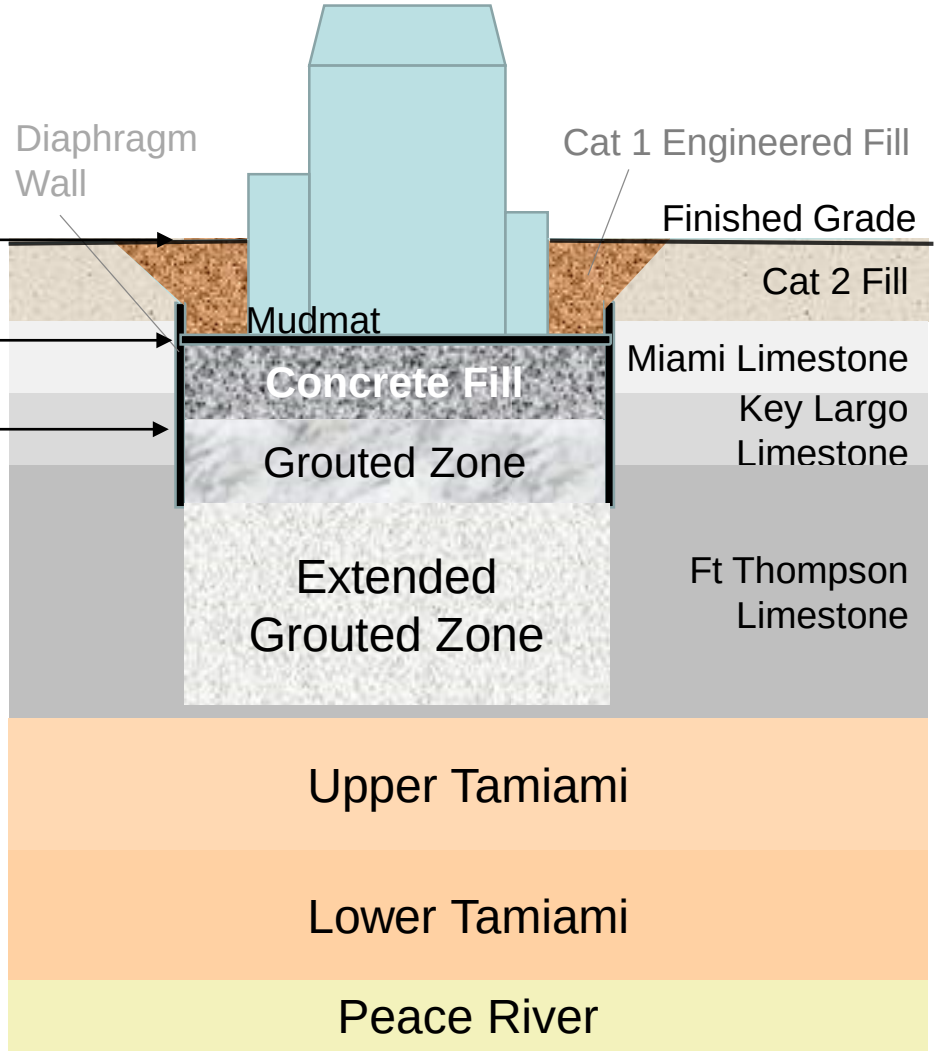
- Engineering backfill is required to raise the plant grade to be consistent with DCD soil profiles.

Review Focus for Section 3.7 – Seismic Design

Performance Based
Seismic Response Spectra
(PBSRS)
Elevation 25.5 ft

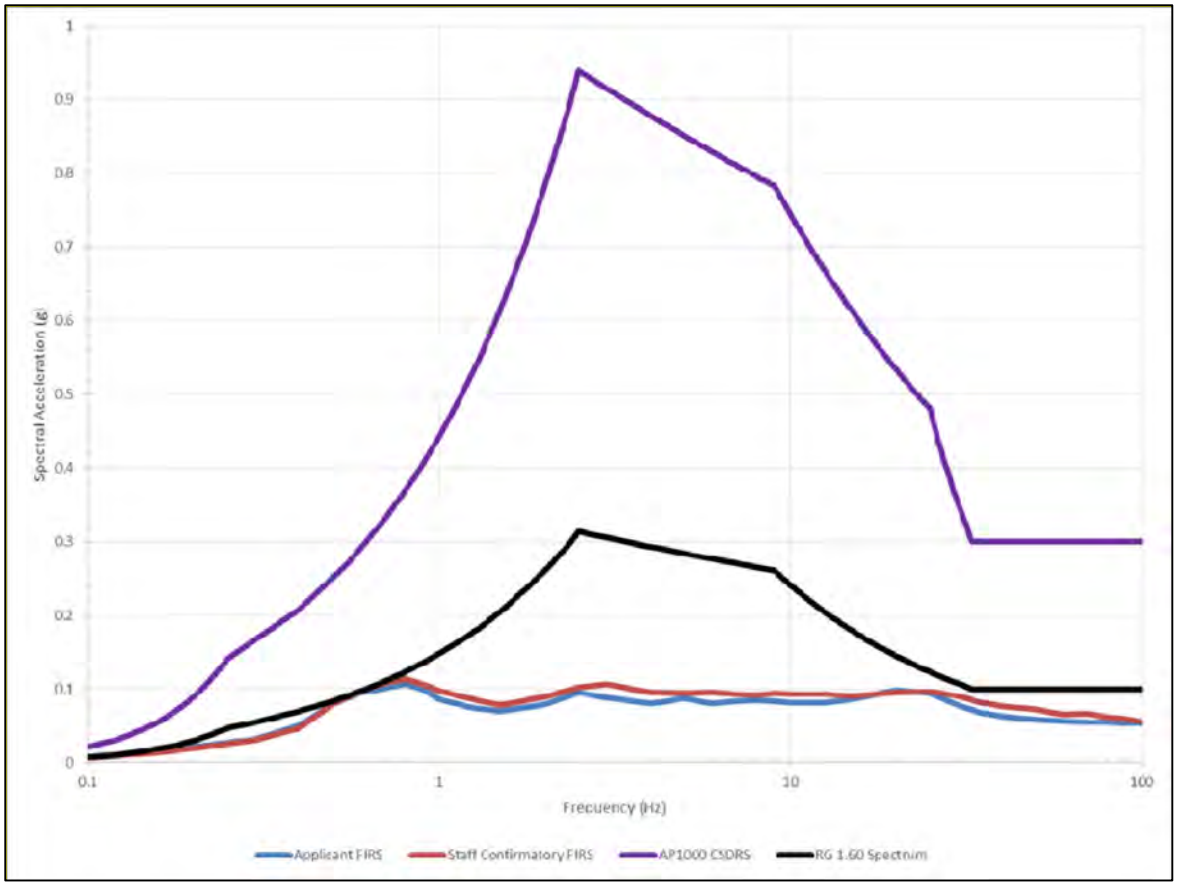
Foundation Input
Response Spectra
(FIRS)
Elevation -16 ft

Ground motion
response spectra
(GMRS)
Elevation -35 ft



PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions



Staff's FIRS Confirmatory Analysis

PTN SUP 3.7-1/SUP 3JJ-1

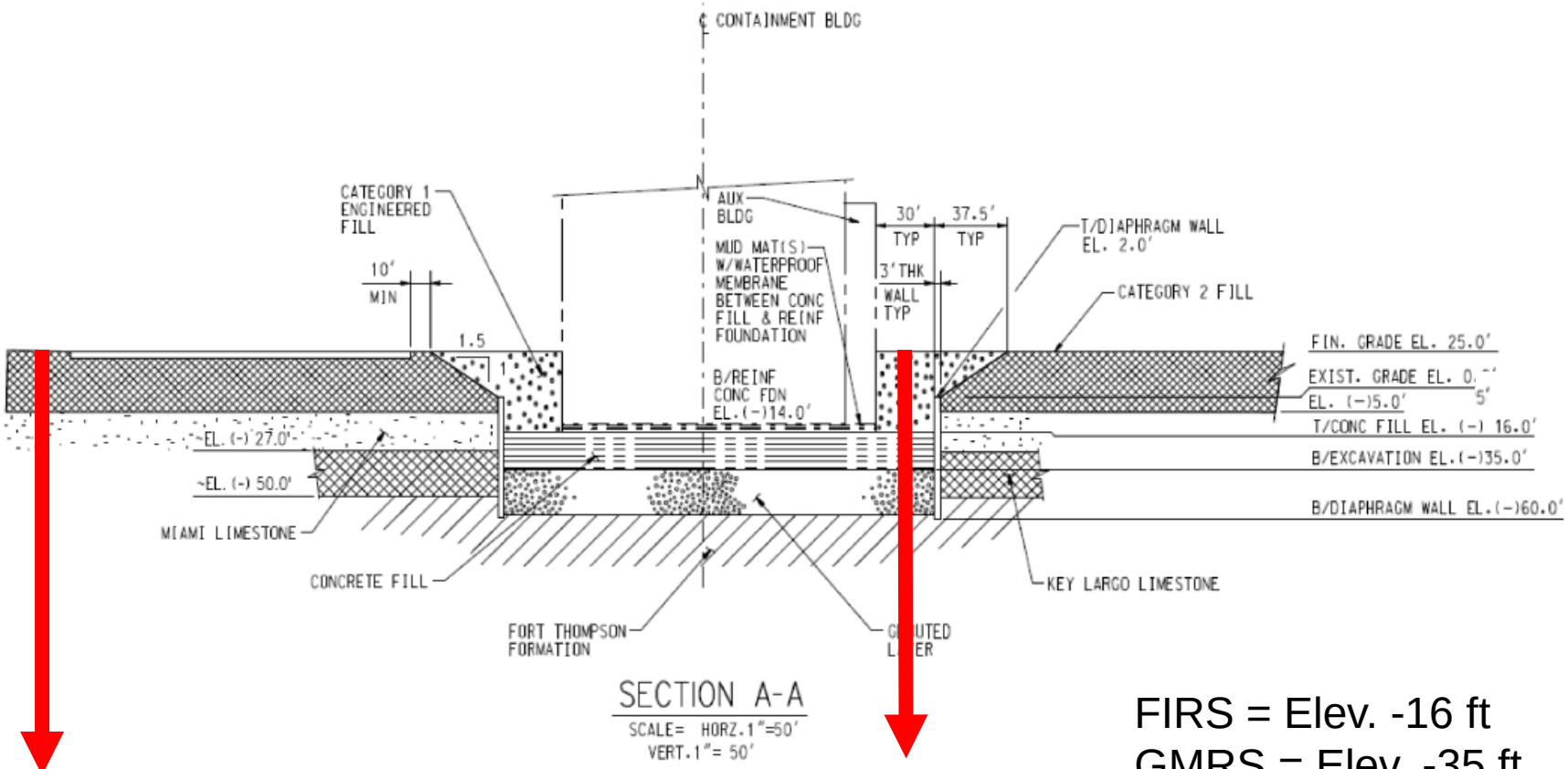
SSI Soil Profiles and Input Motions

Resolution

- The staff performed confirmatory site response analyses using only the near-field site profile developed for the NI along with the same input response spectra used by the applicant. The staff used estimated values of stiffness and damping coefficients for the proposed fill materials to develop FIRS for the site profiles.
- The staff developed FIRS at the foundation level to check the minimum required ground motions per 10 CFR Part 50, Appendix S. The site-specific safe shutdown earthquake (SSE) is the envelope of the FIRS and RG 1.60 spectra scaled to 0.1 g.
- The FIRS and surface PBSRS are well below the AP1000 certified seismic design response spectra (CSDRS).

PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions



Far-field

Near-field (NI)

FIRS = Elev. -16 ft

GMRS = Elev. -35 ft

PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions

Issue

Applicant performed supplemental subsurface investigations at site that resulted in changes to geotechnical site characterization

- In updated analysis, applicant used an approximate process to update soil profiles and include grouted near surface rock layer in evaluation

PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions

Resolution

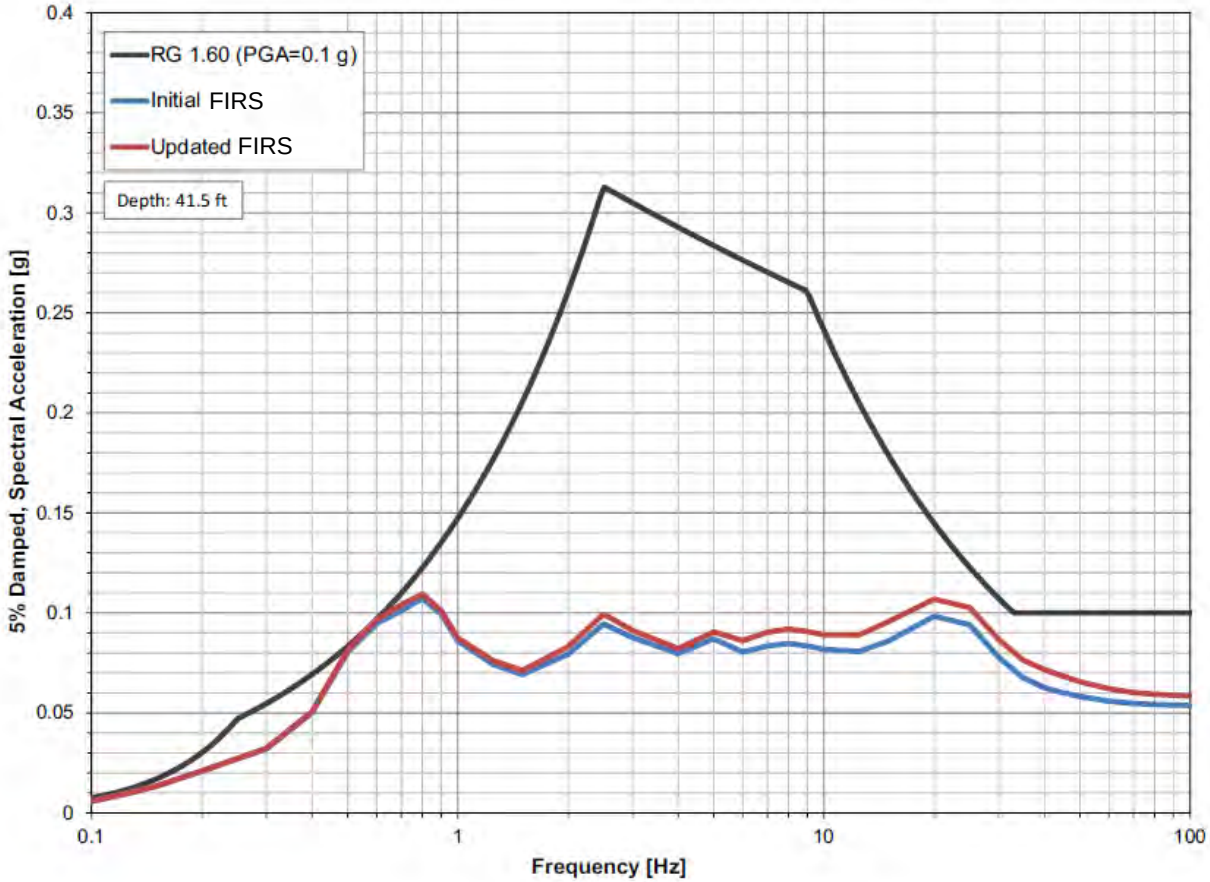
- Sensitivity analyses were performed that show that the updated profile will not significantly change the computed seismic demands.

- The site-specific SSI analysis of the facility was performed to the envelope of the FIRS and RG 1.60 spectra scaled to 0.1 g. The updated profile does not result in a significant change.

- Both the original and updated profiles are enveloped by the 10 CFR Appendix S requirement for minimum seismic input of 0.1 g horizontal peak ground acceleration at the foundation level.

PTN SUP 3.7-1/SUP 3JJ-1

SSI Soil Profiles and Input Motions



Initial and Updated FIRS Comparison

PTN SUP 3.7-2/SUP 3KK-1

Seismic Category II/I Interaction

Issue

Site-specific modeling and analysis of seismic Category I and II structures considers effect of postulated subsurface voids

- Applicant analyzed potential impact on stability of overlying soils, structure foundations, and seismic Category II/I interaction.

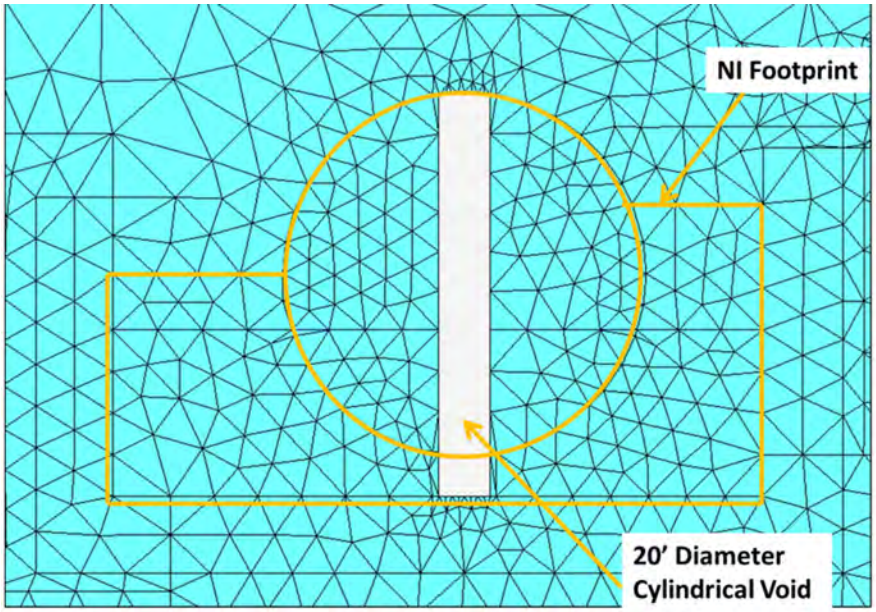
PTN SUP 3.7-2/SUP 3KK-1

Seismic Category II/I Interaction

Resolution

- Applicant postulated a maximum 20’ spherical void based on borehole spacing
- Applicant performed a conservative 2D pseudo-dynamic analysis considering the presence of 20’ diameter cylindrical void beneath the NI and turbine building

Figure Source: Response to RAI 2.5.4-26



- Evaluations demonstrates that seismic Category II structures will not interact with seismic Category I structures

PTN SUP 3.7-2/SUP 3KK-1

Maximum Relative Displacement between NI and Adjacent Building Foundation

Issue

Applicant computed probable maximum relative displacement between NI and adjacent building foundations

- Seismically induced lateral deformation for soils surrounding NI must prevent contact between adjacent structures

PTN SUP 3.7-2/SUP 3KK-1

Maximum Relative Displacement between NI and Adjacent Building Foundation

Resolution

- Maximum relative displacement computed by applicant is 0.05 inches at foundation and 0.174 inches at top of structures
- Computed displacement between NI and adjacent building is less than 2.0 inch gap required per DCD
- Interaction between NI and adjacent buildings is not a concern.

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Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 13, Conduct of Operations
Section 13.3 – Emergency Planning

August 19, 2016

13.3 Emergency Planning

- Emergency Operations Facility (EOF)
  - Common EOF (Units 3, 4, 6, 7)
    - Located 26 miles from Turkey Point site at existing FPL General Office building in Miami, FL
    - Back-up Technical Support Center (TSC) & Operations Support Center (OSC) (Hostile Actions)
  - Meets NUREG-0696 guidance
    - Size, Data Displays, Comm., Human Factors
  - ITAAC 1.1, 3.1, 3.2, 5.2, 6.1, 6.4, 6.7, 8.1.1.D

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Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 19, Probabilistic Risk Assessment

August 19, 2016

Departures from the AP1000 DCD

19.41 Hydrogen Mixing and Combustion Analysis

ITAAC revised to reflect location of CMT compartment opening

19.58 Winds, Floods, and Other External Events

- Extratropical cyclone frequency
- Aviation accident frequency

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Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 20, Requirements Resulting from Fukushima Near Term Task Force Recommendations

August 19, 2016

ASE Chapter 20 - Requirements Resulting from Fukushima Near Term Task Force Recommendations

This chapter address the Fukushima Near-Term Task Force recommendations that are applicable to the Turkey Point Units 6 and 7 COL application.

The applicable recommendations address:

- **Recommendation 2.1:** Reevaluations of the seismic and flood hazard
- **Recommendations 4.2:** Mitigation strategies for beyond-design-basis external events
- **Recommendation 7.1:** Spent fuel pool instrumentation
- **Recommendation 9.3:** Emergency preparedness staffing and communications

Recommendation 2.1: Seismic and Flood Hazard Reevaluations

- The staff determined that the applicant has already addressed the seismic and flood hazard reevaluation portion of Recommendation 2.1. Therefore, there are no additional requirements left to be addressed in Recommendation 2.1 for seismic and flood hazard reevaluations applicable to the Turkey Point Units 6 and 7 site.

Recommendation 4.2: Mitigation Strategies for Beyond-Design-Basis External Events

- The staff reviewed the mitigating strategies for Turkey Point Units 6 and 7 to provide assurance of core cooling, containment, and SFP cooling capabilities in the event of a beyond-design-basis external event resulting in an ELAP event.
- The staff finds that the approach for mitigating beyond-design-basis external events to be used at Turkey Point Units 6 and 7 is consistent with NRC Order EA-12-049 and both general and AP1000-specific NRC guidance (including NEI 12-06, Appendix F, as endorsed by the NRC staff).

Recommendation 4.2: Mitigation Strategies for Beyond-Design-Basis External Events

- The staff will impose a license condition as discussed in this ASE to verify the implementation of the mitigation strategies for beyond-design-basis external events at Turkey Point Units 6 and 7.
- **License Conditions:**
  - Requires completion of an integrated plan, prior to fuel load
  - Implement procedures, training, acquire support equipment and have in place a preventive maintenance program.
- The staff finds the strategies for beyond-design-basis external events for the Turkey Point Units 6 and 7 acceptable.

Recommendation 7.1: Spent Fuel Pool Level Instrumentation

- The spent fuel pool instrumentation shall be maintained available and reliable through the development and implementation of a training program. The training program shall include provisions to insure trained personnel can route the temporary power lines from the alternate power source to the appropriate connection points and connect the alternate power source to the safety-related level instrument channels.

- The staff concludes the provisions for SFP instrumentation arrangement, qualification, power sources, accuracy and display are consistent with the recommendations described in SECY-12-0025 and Commission Order EA-12-051.

- The proposed license condition is acceptable because it provides that, prior to fuel load, the licensee will have in place procedures for the proper maintenance of the level instruments and for the connection and use of an alternate power source in order to power the level instruments.

Recommendation 9.3: Emergency Preparedness Regulatory Actions

- Emergency Plan describes dedicated and diverse communications capabilities between control rooms, TSC, OSC, and the EOF including links between:
  - Affected unit to dispatch OSC teams and OSC, TSC, and Control Room
  - ED, EPM, and shift supervisor/EPOS and affected unit control room, TSC, and EOF
  - TSC, affected unit control room, and the EOF for transmission of technical data
  - TSC and EOF to discuss mitigating activities and priorities
  - Activated facilities as a communication link

- Phone links in station have diverse and back-up power supplies

Recommendation 9.3: Emergency Preparedness Regulatory Actions

- Communication and staffing assessments addressed by license conditions, one for staffing assessment and another for communication assessment
- License condition requires at least 18 months before latest date set forth in schedule for completing the ITAACs that assessments will be completed for both communications and staffing using approved NEI 12-01
- 180 days prior to fuel load corrective actions identified during assessment must be incorporated and plan must identify how augmented staff will be notified given degraded communications capabilities
- Staff finds license condition acceptable because it conforms to the guidance and applicable regulations

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Staff Presentation to ACRS Subcommittee

Turkey Point
Units 6 and 7 COL Application

ASE Chapter 21, Design Changes Proposed in Accordance with ISG-11

August 19, 2016

Design Changes Proposed in Accordance with ISG-11

- Issues generic to Certified Design presented to ACRS on Levy County docket have been incorporated into Turkey Point application
- FPL exemption requests related to five ISG-11 AP1000 design changes are evaluated in ASE Ch. 21

ISG-11 Design Changes to AP1000 Certified Design	ADAMS Accession No.
Passive core cooling system containment condensate return	ML16132A293
Main control room dose	ML16140A087
Main control room heatup	ML16131A674
Hydrogen vent inspections, tests, analyses, and acceptance criteria	ML16124A922
Neutron flux logic operating bypass	ML16124A921